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CONTENTS.

An Asterisk (*) Denotes an Illustrated Article.

OFFICIAL NOTICES—

Fifth Annual Meeting, Iowa District Gas Association..... 917

Second Annual Meeting, Canadian Gas Association..... 917

NOTICES—

Wrinkle Department, American Gas Institute..... 917

Our Half-Century Special Number..... 917

EDITORIALS—

Briefly Told..... 918

The Eighth Annual Meeting, Wisconsin Gas Association—Duty of a Company to Furnish Safe Tools and Appliances—Current Mention.

*Accidents that Might be Avoided, by "R."..... 919

Proceedings, Thirty-ninth Annual Meeting, New England Association of Gas Engineers—Continued from Page 877..... 919

First Day, Afternoon Session—*Tar for Roads, by Mr. C. B. Price, Malden, Mass.—Discussion—*Why The Gas Man Should be an Illuminating Engineer, by Mr. Norman Macbeth.

Proceedings, Fifth Annual Meeting, Illinois Gas Association—Continued from Page 881..... 928

First Day, Afternoon Session—Discussion on the Paper (Two Parts) on "An Investigation of the Effects of Compression and Transmission in the Candle Power and Heat Units of Manufactured Gas," by Messrs. Rafferty and Bates (Part I.) and Messrs. Cole and Houghton (Part II.).

SPECIAL ENGLISH CORRESPONDENCE..... 929

Tar as a Dust Preventative—Suction Gas versus Town Gas—Small Gas Engines.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 930

Contracts for R. D. Wood & Co.—The Laboratory of Engineering Chemistry, Boston—Mr. Addis Goes to Brattleboro, Vt.—The Milwaukee Company's Memoranda for Architects and Builders—The Griffin Brochure—They Lunched the Business Men, Little Rock, Ark.—A Fast Team—Canarsie Wants Gas—To Increase the Capital Stock—Annual Meeting, Waukesha, Wis.—Gas Rate Fixed, Redlands, Cal.—U. S. War Department and Its Ballooning Stations—And Other Items.

The Market for Gas Securities..... 932

JUST prior to going to press we received the following dispatch:

BOSTON, MASS., May 21, 1909.

I regret to advise you that Uncle "Fred." J. Davis died this morning.—H. A. NORTON.

[OFFICIAL NOTICE.]

Fifth Annual Meeting, Iowa District Gas Association.

OFFICE OF THE SECRETARY AND TREASURER,
DES MOINES, IA., May 20, 1909.

ANNOUNCEMENT.

The fifth annual meeting of the Iowa District Gas Association will be held in Waterloo, Ia., June 23, 24 and 25, 1909. The following papers will be read:

"Construction and Operation of a Gas Works in a Town of Five Thousand Inhabitants or Less;" by Mr. Thos. Crawford, Clinton, Ia.

"The Gas Meter: Its Construction, Operation, Sources and Causes of Error, and Its Reliability as a Measuring Device;" by Mr. R. H. Lawlor, Waterloo, Ia.

"The Operation of the Modern Carburetted Water Gas Machine;" by Mr. Wm. J. Bertke, Sioux City, Ia.

"Mutual Interests of the Gas Company and the Community;" by Mr. George McLean, Dubuque, Ia.

"Organizing and Pursuing New Business Campaigns;" by Mr. E. H. Martin, Des Moines, Ia.

"High Candle Power Competition;" by Mr. Elmer Crady, Sioux City, Ia.

Three topic will be discussed in addition to the papers:

"Keeping Ice Out of Steel Holder Tanks and Cups."
"Methods of Disposal of Waste Water from a Gas Works."
"Progress of Tar Market During the Year."

Two special features will form a part of the programme:

1. *An Exhibit of Appliances.*—Suitable space has been leased by the Waterloo Gas Company and is offered free to manufacturers. For details, communicate with Mr. R. H. Lawlor, Chairman, Waterloo, Ia.

2. *An Open Session.*—For free discussion, without a stenographer, will be held the evening of June 23d.

G. I. VINCENT, Sec'y and Treas.

[OFFICIAL NOTICE.]

Second Annual Meeting, Canadian Gas Association.

OFFICE OF SECRETARY-TREASURER,
WOODSTOCK, ONT., May 11th, 1909.

The second annual meeting of the Canadian Gas Association will be held in Montreal, Canada, Friday and Saturday, June 18th and 19th, 1909.

Papers of a most interesting and instructive nature are being prepared and the announcement of their titles will be made later.

Arrangements are in the hands of an entertainment committee for the entertainment of delegates, outside of business meetings.

Montreal is Canada's largest city, beautifully situated, and affords great opportunities for entertainment. There are several large, first-class hotels, but reservations should be made early. The business meetings will be held in the Windsor Hotel. Yours very truly,

A. W. MOORE, Secretary-Treasurer.

[NOTICE.]

Wrinkle Department, American Gas Institute.

WRINKLE DEPARTMENT, AMERICAN GAS INSTITUTE,
OFFICE OF EDITOR, GAS OFFICE BUILDING,
DETROIT MICH, March 12th, 1909.

To the Members, American Gas Institute: All members of the American Gas Institute are earnestly requested to forward contributions for the Wrinkle Department as soon as possible.

Your co-operation determines the success of the Department.

F. L. CROSS, Editor.

OUR HALF-CENTURY SPECIAL NUMBER.

Next month we complete our Fiftieth Year. To commemorate it fittingly the proprietors have determined to print a special issue, on the pages of which will be given a fair history, and at some length, of the progress made in the gas industry since the JOURNAL first appeared to champion the cause. The issue is to have 1[illegible] pages, with

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special cover, the size of the pages to be even with those in the regular edition. One-half the issue (50 pages) will be given to the publication of articles (14 in number) on the leading phases of gas manufacture and distribution, the sketching of the articles to be historical. These articles are in course of preparation by men whose eminence in the profession cannot be gainsaid, and each of them is addressing himself to a subject regarding which he undoubtedly possesses expert knowledge. The remainder of the issue will be given over to advertising, the rates for which are as follows:

One page $50.
One-half page $25.
One-quarter page $13.

The cover pages, inside and out, have been engaged (these were let at figures approximately 200 per cent. higher than the "inside") and 43 of the interior pages have also been contracted for. The edition will go free to everyone of our regular subscribers and advertisers, and extra copies will be furnished at the rate of 50 cents each. No concession in price will be made for orders for extra copies to anyone. Those who desire to advertise, and those who wish to secure extra copies, should address the publishers at once. No undue claim to excellence is made when it is stated that this special issue will contain more in value to the fraternity than was contained in any other issue of any gas news periodical ever printed.

BRIEFLY TOLD.

THE EIGHTH ANNUAL MEETING, WISCONSIN GAS ASSOCIATION.—Our advices respecting the eighth annual meeting of the Wisconsin Gas Association are not as complete as was hoped for, but enough came to hand in desultory way going to show that the convention lacked neither in interest, worth nor attendance. The latter numbered well on to four score, and the accessions to membership were close to twenty. The address, by President Douglas, was in that gentleman's best vein, and his remarks respecting the course that is being pursued by the Wisconsin Public Utilities Commission are, to say the least, reassuring. Further, they are bound to have close scrutiny from those in other States—notably, New York—who are under dominion of kindred type. The paper list was notable for several practical papers, two of which bore intimate relation to phases of the business that are intimately connected with the better disposition of residuals. These were: "Ammonia Recovery at Gas Works," by Mr. John S. Unger, and "Tar Macadam Pavements," by Mr. J. D. Taylor, Jr., of Wausau. This sort of matter must make those who hear it forcibly and clearly presented think well over its proved application A visit of inspection to the Racine Gas Light Company's handsome plant was much enjoyed. On the social side the main feature was the banquet at the Hotel Pfister; although this was well supplemented by lesser or more informal "joys." The officers elected were:

President.—R. B. Brown, Milwaukee.
Vice-President.—W. H. Ellis, Appleton.
Secretary and Treasurer.—H. H. Hyde, Racine.
Director (to serve 2 years).—S. J. Glass, Milwaukee.

The next meeting will be held in Milwaukee.

DUTY OF A COMPANY TO FURNISH SAFE TOOLS AND APPLIANCES.—A case recently tried that is of especial interest to gas men is that of O'Toole *v.* New England Gas and Coke Company, which was argued in the Supreme Judicial Court of Massachusetts; 87, N. E. Reports, 608. A summary of the decision is appended: The plaintiff, in an action against a Gas Company, was an employee of the Company, and at the time of the accident for which he sued was engaged loading bricks into a wheelbarrow, while standing on a scaffolding 4 feet in width. One of the legs of the wheelbarrow being shorter than the other, the barrow overturned during the process of loading, throwing the plaintiff from the scaffolding to the ground. A verdict was given in favor of the plaintiff on the theory that the Company had not complied with its legal obligation to furnish its employee with safe appliances with which to do the work required of him. While this obligation is imposed by law upon the employer, the employee, on his part, must use reasonable care for his own safety with reference to the tools and appliances furnished. If, when furnished with an inadequate tool, or unsafe appliance, the workman fully comprehends its defects and imperfections, and voluntarily proceeds to use it, he must abide by the consequences; for, having assumed the risk, he is precluded from recovery. The plaintiff admitted that he had noticed, while wheeling the barrow when loaded with bricks, that it was "a little shaky;" but this, it was held, fell short of constituting a knowledge of the disparity in the length of the legs or of the danger likely to ensue from its use. It was also held that, considering the narrowness of the platform, and the fact that there was neither rail nor guard on the side, the plaintiff was not guilty of contributory negligence in standing between the handles of the wheelbarrow while it was being loaded.

CURRENT MENTION.—

"THE May meeting of the Chicago Section of the Illuminating Engineering Society was held in the German rooms of the Grand Pacific Hotel, Thursday noon, May 13th. Luncheon was promptly served at mid-day, and there can be no doubt about the fact that this mid-day hour plan is going 'to do' in Chicago at any rate, for the attendance was excellent, and every 'attender' undoubtedly had his appetite with him. The speaker was Prof. W. E. Barrows, of the Armour Institute of Technology, whose address (Secretary Geo. Harvey Jones, rather unfeelingly in his final notice of the gathering, referred to this as 'a talk') had to do with the subject of Instruction in Illuminating Engineering as practiced in the Armour Institute of Technology. This Institute was amongst the pioneers in establishing a short course in illuminating engineering consequent upon the regular course in electrical engineering. The simple statistics furnished by Prof. Barrows spoke much for the good work that is being accomplished at Armour Institute along these lines. The Professor is a good card talker, all right.—VON."

How can they deny him? No; not successfully. We refer to Col. Paul Doty, who, on the occasion of the annual meeting of the Business League, of St. Paul, Minn., was translated from underling to the President thereof. Amongst other things which the League accomplished for the handsomer half of the Twin City, was a cash contribution of $2,500 to the hospital for crippled and deformed children. Of a surety the Business League, in the midst of its desire to secure greater hotels, grander business houses, and temples of religion, science and art, forgets not the maimed, the blind and the halting. During the year the League succeeded in inducing 13 large business concerns to establish headquarters in the city, prominent in these being houses whose reputations are international—for instance, Jno. Wyeth & Bros., of Philadelphia; the American Naval Stores Company, of Chicago; the Patterson & Sargent Co., of Cleveland, and the like.

MR. A. S. B. LITTLE, Engineer to the Gas Works division of the Evens & Howard Firebrick Company, says that their recent orders include one from Platteville, Wis., where 2 new arches with benches of half-depth 6's are being put in. He declares that quite a new style of ironwork is to be adopted there, the mains being separate as far as the tar is concerned, each section being fitted with separate overflow. The Boonville (Mo.) Company also authorized the Evens & Howard folks to renew some settings (3 in number), the arches for which were built in 1890 from Evens & Howard No. 84 plan of 3's. The date of the plan is 1885.

SOME evenings ago a regular meeting of the Employees' Association of the Suburban Gas Company, of Philadelphia, was held in the offices of the Company, South and Welsh streets, Chester, Pa. A well put together paper on "The Construction of Gas Meters" was read by Mr. John Stainton, which gave rise to a valuable discussion. Another feature of the evening was the election of 12 new members, which rather goes to show that "Fred." Shelton and his associates were not far wrong in their judgment some years ago when they declared that the best thing possible for the advancement of a Company's material interests was to bring its employees - of high and low degree—into as close a bond of fellowship as possible.

THE ninth session of the Summer School for Artisans, University of Wisconsin, begins June 28, continuing for 6 weeks. Courses are offered in steam and gas engines, electricity, machine design, mechanical drawing and allied subjects. There are no entrance requirements, the purpose of this school being to offer practical instruction, by lectures and laboratory practice, to young men in the trades. Certain advanced engineering courses are offered for those having the requisite preparation, and the general University summer session, held during the same period, allows opportunity for a wide choice in subjects of instruction. A new feature of the coming session will be courses in "Public Utilities' Testing and Accounting," for those desiring to become familiar with the requirements of the Railroad Commission of Wisconsin, which has the administration of the Wisconsin Public Utilities Law. Information may be obtained from F. E. Turneaure, Dean, College of Engineering, University of Wisconsin, Madison, Wis.

Accidents that Might be Avoided.

[Prepared for the JOURNAL, by "R."]

Insurance engineers are constantly coming into touch with accidents which, if proper precautions had been taken, might have been avoided. In fact, persons who themselves were in the accident often realize that the accident was due to carelessness A considerable proportion of the accidents in manufacturing establishments, mines and mills can be traced to negligent work relative to supporting devices, scaffoldings, stageing, ladders, gangplanks, etc. In this article we intend to refer in particular to accidents in mines and quarries or places where ladders, with kindred devices, are employed. The common ladder has been the subject of discussion in many mines and shops because of its treachery, and numerous accidents have been recorded against the ladder in recent years; yet, in many instances, the ladders were not at fault. In one case, in which it had been announced that a miner had been injured by a defective ladder, it was found that the ladder was constructed with a single pole, as in Fig. 1. The pole was provided with the steps or rungs made of hardwood, inserted through bores in the pole. Then at the top was a metal hook. This ladder is similar to the scaling ladders of a fire department, and unless a man is trained he cannot readily ascend and descend this type of ladder, for it is always straight up, not inclined, like the common ladder, and, therefore, it is difficult to get a grip on the same.

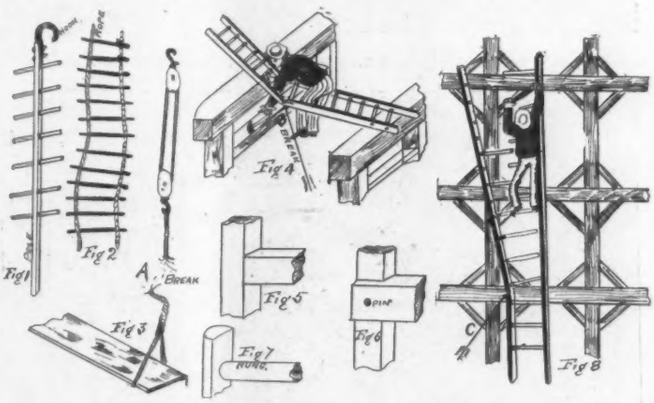
The ladder hangs by means of the wrought iron hook, and it sways with the party on it. A misstep is made, or the balance is lost; the man falls and is injured; damages are filed; the outcome cannot be foretold. Mining engineers have discarded this form of ladder in many plants. Then, again, miners often introduce the dangerous rope ladder, of the form shown in Fig. 2. In fact, you can find rope ladders employed in all kinds of work, but these rope ladders are dangerous, because of their liability to break. A heavy man will almost always snap the side rope of a rope ladder, as the side ropes are never very heavy. If they were they would be too bulky, hence they are made small. The ropes soon get weak through decay and the rungs help do the rest. Then someone mounts the ladder and gets a fall, and once more damages are claimed. The question of the risky rope comes up often. Owing to the many suits usually in hand, due to the operatives filing them against the companies for permitting the use of poor stageing material, the mine owners are getting quite shy. They have frequent inspections made of ropes, tackles, ladders, stageing, etc., yet there are weak points which often escape notice. Not long ago a stageing supporting rope snapped off, as at *A*, Fig. 3, due to a defect in the rope. Instances of this description are common. Often the rope will separate where the union has been made in the formation of the loops. Chains cannot be used very well in work of this nature because of the weight. Even the chains get rusted, corroded and correspondingly weakened.

The mining companies have to trust a great deal to luck. They estimate upon a certain number of accidents during the season, and a sum of money is prescribed annually for the accident fees necessarily paid to the employees. In many instances the mining organization is able to settle simple accident cases without the injured man filing his claims in the court. Frequently an agent of the company can arrange for the man's pay to go on during his recovery; or the board bill is paid; or a sum of money is given over. In serious cases, however, the courts are appealed to and considerable annoying testimony is taken about inspections, ropes, apparatus, etc. Ropes are sure to weaken in the damp atmosphere of the mine. A rope which is estimated to bear a certain weight under normal conditions often fails to bear up one-half the weight when put to actual service in a mining department. The first intimation that the workmen get is the straining and cracking of the breaking strands in the rope. The fracture occurs and the men fall with the stageing. Hundreds of such falls happen every week, in which men escape with slight injury and no serious report is made. In one fall the man saved himself by griping the swaying end of the block-and-tackle, where he hung until relieved. He was not hurt, so that the incident was forgotten in a few days. Had he fallen, serious injury would have resulted, investigation would have been made, and some foreman would have gotten into trouble.

Ladders are a source of expense and bother to the mining companies, as is known. Sometimes a careless employee gets into trouble with a ladder, as shown in Fig. 4. In this case the workman, who was by no means a light man, placed the ladder across a space intervening between two beams. When midway the ladder broke, as at *B*. The man fell 30 feet and was severely injured. It cost the company several hundred dollars for surgical fees, board, wages, etc. Suit was then filed against the company for having a poor ladder. The months of investigating resulted in exonerating the company because the man had no business in making a bridge of the ladder.

In the suits which come up, various ways of making ladders for mines are brought up. In some cases it is found that the rungs are simply pieces of boards nailed on the sides. This is a dangerous proceeding, as the steps are liable to be forced away from the nails. Sometimes the rungs are tenoned into the sides, as in Fig. 5. Or the steps may be united with a wooden pin, as in Fig. 6. The common rung method is shown in Fig. 7.

I remember a case in which a man got a bad fall due to the sides of the ladder spreading. Fig. 8 is a drawing of what happened. The



man was part way up out of a shaft when the left side of the ladder dropped off, breaking at the weak point, *C*. In this case the mining company realized that it was at fault in retaining a ladder in shape to fall to pieces. A check for a goodly sum was drawn for the workman and the matter was dropped.

[PROCEEDINGS, AS FURNISHED BY THE SECRETARY.—Continued from page 877.]

PROCEEDINGS, THIRTY-NINTH ANNUAL MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

HELD IN YOUNG'S HOTEL, BOSTON, MASS., FEB. 17, 18, 1909.

FIRST DAY—AFTERNOON SESSION.

On motion, Mr. Klumpp was awarded a vote of thanks for his address on "Calorimetry." The President then introduced Mr. C. P. Price, of Malden, Mass., who read the following paper on

TAR FOR ROADS,

which was illustrated by a number of lantern slides:

Fig. 1.—Preparing Roadway—Removing Loose Materials.

The macadam road—that is, the ordinary stone road—has been made to serve the purposes of ordinary travel in this country up to within about 5 years ago. These roads are constructed to take horse-drawn vehicle traffic, the pound of the horses' feet and the rolling of the steel-tired wheels, on the principle that the road was practically self-

Fig. 2.—Applying Material—Using Tank Wagon and Hose.

Fig. 6.—Kettle Used for Heating Tar and Asphalt.

Fig. 3.—The A. T. C. Distributor, a Machine Especially Adapted for Applying Light of Heavy Tar.

Fig. 7.—Applying Bituminous Material to the Stone on Mixing Board.

Fig. 4.—Method of Repairing a Tar Painted Surface.

Fig. 8.—Mixing Stone and Bituminous Material and Spreading.

Fig. 5.—Applying Material by Means of a Tar Kettle and Hose.

Fig. 9.—Top Course of Tarred Stone in Place.

supporting until it wore down to the lower course of stone. The horses would pound up the surface, the wheels would roll it and the rains would water it, thus maintaining a smooth surface. Until the automobiles came this road was perfectly satisfactory. It was expected to last 10 years under ordinary country travel; but when the motor cars appeared these roads were found absolutely unsatisfactory.

Bituminous macadam I believe is the whole solution of the road problem; it is the best they have found so far, anyhow. Prof. Blanchard, the State Engineer of Rhode Island, after a great many

Fig. 10.—Methods of Applying Flush Coating.

Fig. 11.—Section of Bituminous Macadam Roadway, East Providence, R. I.

experiments, using straight coal tar, and mixtures of coal tar and asphalt, found that in some places straight coal tar was preferable, but that in other locations the addition of a little asphalt was a great advantage. He found difficulties, however, in using the asphalt alone; he could not make it stick to the cold road material, unless it had been previously heated.

The following descriptions explain briefly the latest and best methods of using tar as a road preservative and in the construction of new roads:

For preserving roads already constructed, the tar painting method is employed. The road surface is swept clean of all loose material and the tar is applied hot, by means of a spreading machine, or it is delivered on the road surface by means of a hose attached to the tar wagon. Whichever method is used, it is necessary to provide several men with "squegees" for removing surplus tar from the depressions in the road, and to prevent the liquid material from running into the gutters. As soon as the tar has been spread, and while it is still hot, a quantity of clean pea-stone should be applied, as even as possible, and immediately afterwards rolled with the steam roller.

Upon the following detail depends the success of the work: The tar used should be refined to the proper consistency; crude tar containing water and ammoniacal liquor is unsuited for the purpose.

The road should be free from dust, and bone dry. The pea-stone to be applied in every case while the tar is still hot.

In constructing tar macadam roads, by the penetration or grouting method, the following specifications are offered as being the latest development of this class of work:

Broken Stone with Upper Course.—Tar Grouted.

Section 10.—Broken, local stone shall be spread, bound and rolled on the roadbed, prepared as hereinbefore described, as follows:

The width of the broken stone shall be 15 feet. The stone shall be laid in 2 courses, the lower of which shall be 3 inches in thickness at the center and 2 inches in depth at the sides; the upper course, 2 inches thick at the center and 1½ inches in depth at the sides. The depths of courses shall in each case be as if measured after rolling.

In both courses the stones shall vary in size from ½ inch to 2½ inches in their longest dimensions.

After the bottom course, above described, is thoroughly compacted, broken stone screenings shall be spread thereon and rolled until the interstices between the stones are filled. The screenings so used may contain the dust and they shall be not larger than will pass through ½-inch mesh.

After the bottom course has been rolled to the satisfaction of the engineer, and evened up to conform to the proposed cross-section, the top course shall be spread and rolled until fairly compact and as the engineer shall direct. When the stones are absolutely dry, a refined tar, conforming in all particulars to the requirements of Section 10a of these specifications, heated to a temperature approximating 180° F., shall be grouted into the voids between the stones of the upper course until all of the interstices are filled with the tar and a thin coating of tar covers the tops of the stones.

The tar may be poured from hods or buckets, or it may be distributed by a hose with a flattened nozzle, or it may be sprayed from any machine of which the engineer approves. If necessary to secure the proper distribution of the tar, and the surface film above required, the tar shall be broomed while hot.

The quantity of tar used shall be not less than 1½ gallons, nor more than 1¾ gallons, to the square yard of surface to which it is applied. As soon as possible, after the tar is applied to the satisfaction of the engineer, a thin, even layer of sand shall be spread thereon to such a depth that after rolling no surplus tar shall appear at the surface. The sand used shall be clean, sharp and dry, free from loam, clay and adventitious matter of all kinds. It shall contain no pebbles which will not pass through a ¼-inch mesh, nor practically any grains or particles which will pass through a screen of 100 meshes to the linear inch.

If the contractor prefers, he may use stone screenings in place of the sand, but such screenings shall conform in all respects to the specifications for sand contained in this section.

When the sand or screenings have been applied the road shall be rolled again to the satisfaction of the engineer.

All rolling shall be done by a steam road roller, of such weight and pattern as the engineer shall approve.

Each course shall be evened up with material of the same sizes and quality as have been used therein, and to the satisfaction of the engineer, and deficiencies or inequalities in the surface of either course shall not be filled with sand or stone screenings. All broken stone shall be spread from the carts by hand, or from a dumping board, or from self-spreading carts. No soft or disintegrated stone shall be used.

If so ordered by the engineer, the thickness of the broken stone shall be increased or diminished at such points as he may direct. The grade of the finished surface of the road shall present a crown of ½ of an inch to the foot.

If local stone, or stone not shipped by rail, is used, it shall be weighed on scales furnished by and at the expense of the contractor. Said scales shall be satisfactory to the engineer, and they shall be sealed at the expense of the contractor as often as the engineer may deem necessary to insure their accuracy. A sworn weigher, to be appointed and compensated by the Massachusetts Highway Commission, shall weigh all broken stone required to be weighed as above provided. If the stone is shipped by rail the car weights will be accepted.

Refined Tar.

Section 10a.—The tar must be uniform in color, character, appearance and viscosity, and must have the following qualities:

a. It shall contain not more than 0.5 per cent. of mineral matter or dirt.

b. It shall have a specific gravity between 1.18 and 1.25.

c. It shall not contain more than 14 per cent., by weight, of free carbon.

d. It shall contain no body that distills at a lower temperature than 225° C.; not over 10 per cent. by weight shall distill below 270° C., and it shall contain at least 65 per cent. by weight of pitch or bituminous material remaining after all bodies up to 360° C. have been distilled.

e. When 20 grams are heated in a flat bottom dish, 3 inches in diameter, for 21 hours, in an oven kept at a temperature of 100° C., the loss shall be not more than 10 per cent., by weight.

f. It shall be of such viscosity that 60 c.c., measured at room temperature (78° F. or 26° C.), shall, when at 100 C., be not less than 85 seconds, and not more than 240 seconds, in passing through a viscosimeter orifice $\frac{5}{64}$ of an inch in diameter when acting under a head of 4½ inches.

g. When 12½ per cent., by weight, of the material is mixed with 87½ per cent., by weight, of sand, of such a grade that all will pass

through a sieve having 10 meshes to the linear inch and practically none through a sieve with 190 meshes to the linear inch and briquettes made 3 inches square and ½ inch thick, such briquettes will so harden in 7 days at ordinary room temperature that, when laid flat, and held by their edges by two parallel knife-edge bars, they shall not bend when a weight is suspended from a third knife-edge, or parallel bar, placed across their center, until this weight reaches 200 grams, and shall not break at less than 250 grams, and the weight causing bending shall not be greater that 80 per cent of the weight causing breaking.

The tar specification given above is considered the best so far issued. It provides very simple and effective tests, and while these tests are considered to be well adapted for comparing various bituminous materials, there is some question as to whether the material that will meet this particular specification is of a quality best adapted for the purpose. It will be noted that the percentage of free carbon is 14. This would, in almost every case, exclude straight coal tar and the admixture of a considerable quantity of refined water gas tar is necessary to meet the test given.

In constructing bituminous macadam roads by the mixing method, the following description gives the details of construction employed by the Rhode Island Department of Public Roads:

The first course of No. 1 stone is laid in place and shaped to the proper grade, and on this surface is laid a 3-inch course of tarred, No. 2 stone. The stones are tarred on a mixing board, as shown in the illustration, the bituminous materials being heated in tar kettles alongside the road. The 3-inch course of tarred stone is thoroughly rolled, and when this work is finished a flush coat of bituminous material is applied on the surface and covered with a light coating of stone screenings, free from flour. In the Rhode Island work, in a number of experiments, an asphalt residuum has been used with the tar and has given excellent results.

The Rhode Island bituminous macadam roads are without doubt the best examples in the United States, and the estimated cost above ordinary macadam is about 21 cents per square yard.

Discussion.

The President—Mr. Price has certainly given us a very interesting paper. I know he will be glad to answer any questions.

Mr. Addicks—I would like to ask Mr. Price how he would treat a macadam road that has been built; whether there is any possibility of treating it with tar in an ordinary repair.

Mr. Price—There is, and it is a very important problem, because there are a great many more roads built now than are building. The ordinary and most approved form of treating a road that is already built and partially worn is to run a scarifier over the surface in preference to this steam roller with picks. The use of a roller with picks on a road is very bad practice. The picks, when they lift out of the ground, injure the foundation of the road, and I do not believe there is a modern road builder to-day who can get a scarifier who will use the other method. The idea in resurfacing a road with tar or any bituminous mixture is to run the scarifier over the surface and loosen up the whole top of the road to a depth of about 3 inches. After that is done you will find, if the road is much worn, low places. Those are to be filled with the No. 2 stone that originally formed the surface of the road. After that new stone has been spread the process then is the penetration method. Mr. Crosby, Chief Engineer of the Maryland Highway Association, told me the other day that he had the best roads in the country, built by pouring the tar on the roads from a bucket. Can you imagine anybody getting an even distribution by throwing tar on a road with buckets? The common method around here is to take a tank wagon fitted with a hose outlet with a fan-shaped piece of tin attached to the end. The men start the team down the road, and a man follows along, splashing the material over the surface. It is absolutely impossible to get an even penetration, and the difficulty with not getting an even penetration of tar is that your whole road will be covered the first warm day with spots of surplus tar, that not only spoil the looks of the road, but those spots of tar will wear out and pick up and the road soon begins to show irregularities. Around Boston, on popular routes of travel, the resurfacing is usually done at a cost of about 35 cents per square yard. That is the minimum figure. I know the city of Boston resurfaced Morton street last year, and the whole resurfacing job disappeared before the end of the season. The reason for this damage was that the road was subject to excessive automobile travel. The automobiles are turned out of Franklin Park, and are obliged to take Morton street in going through to Blue Hill avenue. That was an extreme case. In the neighborhood of Weston, up that way, the State highway people resurfaced a long stretch of road. There the stone was soft and disappeared absolutely in one season. It cost 35 cents a square yard, and they were worse off at the end than they were at the beginning of the season. If with that resurfacing treatment, say 2 inches—they usually put in about 2 or 3 inches of stone—they had put in some bituminous binder, the road would have lasted for 3 or 4 years. It is expected that these bituminous roads must last 10 years, otherwise the expense is too great. On the Wenham road there is a very interesting experiment, right at Wenham station. There they have built the road in the square by the mixing method. They used all sorts of combinations of tar and asphalt, and found that the additional cost, over and above the cost of straight macadam, was about 20 cents. The way the highway people—I am not referring to the Massachusetts Highway Commission—will look at the proposition is this: They say, "If the road lasts 5 years, and it has cost us 20 cents a square yard to build it, it is costing us 5 cents a square yard per year; and that is too much." Of course, if it lasts 10 years without any great amount of repairs, it reduces the additional cost over and above the macadam to about 2½ cents a square yard; but on the ordinary State highway to-day I don't know of any recently built roads that last 2 years without extensive repairs. On the ordinary macadam road, before the advent of the automobile, they used to allow about $100 per mile, regardless of the width of the road. Most of the roads were about 18 feet wide; and it will be seen that, at 5 cents a square yard, a mile of 18-foot roadway is about $500, and if that is an annual tax on each mile of road it is too much. In France, where labor is very cheap, they have a very fine system of maintenance, one that we ought to adopt in this country, where they allow $275 a mile for government roads; but, at the rate of wages and the hours that the men work, that would in this country amount to 2 or 3 times that figure. In the experiments in Washington with automobiles they discovered the interesting point that an automobile does not do any damage to a road until it goes faster than 15 miles an hour. But most of the automobile people don't think there is any pleasure riding at a lower rate than 15 miles. Over 15 miles an hour the damage done by the rubber tires increases very greatly with the increase in speed. I don't remember the radius of the curve, but Mr. Page stated that, in going around a short, easy turn, the damage done to the road by the automobile was 116 times as much as it was on a straight road; and you will notice, wherever there is a curve on a State highway, the road is usually worn down to the No. 1 stone.

The President—Any further questions?

Mr. Gardiner—I think this subject of tarred roads is of the very greatest importance to the gas business. Last year I had an opportunity to observe, at length and in detail, the operation of some tarred roads versus oiled roads at Manchester-by-the-Sea, where I am during the summer, and it called to my mind the necessity of being extremely careful as to the uniform distribution of the tar. Among the summer residents a great deal of feeling was aroused by the fact that in some streets, the tar apparently not having been uniformly distributed, puddles formed, especially after hot days. These puddles of tar were tracked around by the passers over the road, children, etc., and into the houses, and caused a marked outcry against the tarred road in spite of the objections to an oiled road. These tar puddles formed after hot days, and formed noticeably at the foot of hills with a southern exposure, seeming to show that there was a sub-surface creepage of the tar. The puddles would appear in the gutters at the foot of the hills with a southern exposure. I think that my observations of the experience down there lead me to believe it was necessary, not only to distribute uniformly, but to differentiate the uniform distribution, using more or less tar, depending on the quality of the road and its location, inclination, exposure, etc. I speak of these objectionable features of the tarred roads I have observed, because I feel sure they can be overcome. Once they are overcome the tarred road will be without a rival.

Mr. Snow—This subject has interested me very materially. I have been trying, at Holyoke, to get our city authorities interested in using tar on roads. Last year they were interested enough to try it, simply as a dust preventative, rather than a macadam built road, although they have done quite a little of that. But the figures I have—that I thought would be of interest—were some the Board of Public Works have given me regarding a section of road that is the main highway between Holyoke and Springfield, a highway that is travelled very extensively by both teams and automobiles. It is a stretch of good gravel road. On it there is some 6,800 feet in one continuous stretch. It was tarred about 20 feet in width, making a total

of 15,150 square yards. The tar was applied by the foreman taking the barrel and pouring it out of the bunghole, while the laborers would spread it round with rattan brush-brooms. I was surprised to see how even a distribution of the tar they were able to produce by that method. Then, after the tar was spread around on the road, it was covered with a thin layer of sand, seemingly not thick enough to really absorb the tar, but sufficint to prevent it being taken up by the wheels, either of horse-pulled vehicles or automobiles. One gallon of tar covered 2.42 square yards. They originally prepared the road, or repaired it, in a way, rounding it up, filling in the depressions before they put the tar on. The amount of labor used in it I thought perhaps might be of interest also. Preparing the surface it took 135 hours of labor, 17 hours for the foreman, 38 hours for teams. On the oiling there was labor of 224 hours, foreman 8½ hours, teaming, 90 hours. This was straight water gas tar, and it gave a beautiful surface to this road. It was an absolute preventive of dust, and the surface of the road looked very similar to a sheet asphalt. It seemed to form a crust over the surface, so that it would take a pretty extensive rain to damage the surface in any way from any washing. The authorities were so well satisfied with the experiment last year that this coming year they will put in several miles. They tried it as well over half a mile of ordinary macadam road, simply as a dust preventive. While that worked fairly well it was not the unqualified success that the treatment of the gravel was.

The President—I think Mr. Morrison has had some experience with using water gas tar on a macadam road.

Mr. Morrison—My experience has hardly lasted long enough to be of much value, but such as it is you are welcome to it. I succeeded in persuading our Road Commissioner to try some straight water gas tar by the absorption method. He put in perhaps 2 miles. It was put on the latter part of the summer, and seemed to stand up very well. Mr. Snow's mention of a crust I think describes it very well. In the case of the macadam road the crust appeared to me to be too thin; it did not seem to soak in far enough. Whether they tried to stretch a gallon too far or not I don't know. The road was first swept clean, all the fine stuff being removed from the bed where the tar was to be used. The tar was delivered into an old watering cart, and simply put on and brushed in with a broom. It looks to me as if one application a year in that way would be very effective, but it has not been on long enough to determine.

Mr. Hawken—This is a case of testimonial, I believe. Last summer I experimented with coal tar on a piece of macadam. We had macadam in the street and along our line of railroad, and I tarred 200 feet. I took a 5-gallon watering pot, put a swallow-tail nozzle on it, with an opening about ¼ inch by 6 inches, and, with this, walking at a fast walk, I applied a thin stream about 10 inches wide. With one application it sank into the macadam about 2 inches. About a month afterwards this had the appearance of an asphalt street. It bonded thoroughly together, and it was pliable, but not very hard. It stood up under heavy trucking and car wheels. I noticed that the wheel flange caused a ridge so that it was necessary to use a pick on the same. In so doing I found that the macadam was thoroughly bonded together. I have heard several concreters say that coal tar and oil gas tar will disintegrate after 2 or 3 years and go to pieces; it is the same with coal tar and asphaltum. After 3 or 4 years a sidewalk will go all to pieces. Those results are what the concreters have found after years of experience.

The President—Have you had any experience with the tarring of roads at Springfield, Mr. Burritt?

Mr. Burritt—Yes, Mr. President. Three years ago we tarred 1,000 feet of macadam road in Longmeadow. Two years ago we went over again the same piece of road with tar and 1,000 feet in addition. Last year we went over the same road again, and plus 3,000 feet more, making 5,000 feet in all. The first year the application was clear water gas tar, the second year a mixture of coal tar and water gas tar, and last year the treatment was a mixture of coal tar and water gas tar; in fact, the formula that Mr. Price uses. This road is used a great deal, of course, for it is the thoroughfare between Springfield and Hartford; but I can say unqualifiedly that the results have been good throughout. Not only has it kept the dust down, but it has preserved the surface of the road to the extent that it has not unravelled at all under the heavy traffic to which it is subjected. We also treated ¾ of a mile of Springfield street up to the City Hospital, that was new macadam road, and nearly ¼ mile at Forest Park avenue this last year, with a mixture of water gas tar and coal tar, with similar success.

Mr. Snow—I would like to add, to what Mr. Burritt said about that Longmeadow road, that I had occasion to go over it this last summer, and will testify that I never saw a better looking piece of road than that was anywhere else.

Mr. Blanchard—Is pitch ever added to the tar to make it of the right consistency? In Montpelier the gas company induced the city to try tar on the road by giving them 50 barrels of tar, but they did not know just how to use it. I think they took a formula of Mr. McDonald's, the State Road Commissioner of Connecticut. Whether or not the Street Commissioner used that formula just exactly I cannot say. I know he added pitch to bring it to the right consistency, then he built a road by mixing the stone with this tar mixture and then rolling it. How this road comes out in the spring remains to be seen.

The President—Mr. Burritt, did you use any pitch?

Mr. Burritt—No, sir; we used no pitch. Simply water gas tar and coal tar mixed.

The President—Any further questions? If not, we will close this subject.

Mr. Morrison—I move a vote of thanks to Mr. Price for his paper [Seconded and adopted.]

The President—The next paper which we will take up is another one that will be illustrated on the screen. Its title is

WHY THE GAS MAN SHOULD BE AN ILLUMINATING ENGINEER,

and its author is Mr. Norman Macbeth.

While the subject of this paper is on "Illuminating Engineering," I know that many gas men and burner salesmen are inclined to the opinion that what they want is not illuminating engineering principles and conditions, but the "How to sell more gas or more burners." I believe that a working knowledge of illuminating engineering is necessary for the success of your business, and the final success of your business is shown by how many 1,000 feet of gas you can sell which will not leave an impression in the mind of the consumer that he is paying "all the tariff will bear," but rather one of pleasant surprise when he realizes how much real service, how much useful illumination he has had for the amount charged.

When a gas salesman advises the use of the right burner in the right place, he is practicing illuminating engineering—doing all that the engineer would do. The basis of success is founded upon a right conception of the work to be done, and the aid which illuminating engineering can lend to the success of the gas company's new business department is, I think, capable of being turned to greater value than any other line.

A definition of what is an illuminating engineer was given a couple of years ago as "An electrical engineer with common sense." This definition has been criticized. No provision was made for the gas man. I would suggest that a gas illuminating engineer to start with be a gas man with uncommon common sense and the ability to sit up and take notice.

Salesmen should know something about the principles of illuminating engineering and be brought to know the difference between good and bad lighting. Mistakes are made in the attempt to show a working knowledge of illuminating engineering, which is conceived to consist of the manipulation of curves, flux factors, coefficients of reflection and other peculiar and mysterious terms. We should always remember that one of the first principles of this science rests on common sense.

Much of the lighting in the past has been of a localized character and the outlets as then installed may be totally unfitted for the best arrangement to-day. Where formerly we were restricted to 20-candle power per burner or per tip, with a distribution not at all favorable, we have to-day many options, and can secure results along lines which were formerly unthought of.

As manufacturers of gas and accessories, we are more prone to look at our output and feel satisfied at the results than to look over the territory and fully realize its undeveloped condition. Selling satisfactory illumination is undoubtedly above gas by the cubic foot or burners by the dozen. It is a proposition, however, which ultimately means more gas and more burners; sales which stay sold. I have found greater business success in rendering the best service possible to all customers, whether the orders were those showing $1 or $10 net profits, and have had many opportunities to note how this policy is appreciated. This policy is to recognize no connection between sales and service. Look after the service and the sales are generally forthcoming.

More talking points should be built about quality, not, of course,

neglecting price, but using favorable cost comparisons more as good measure to finally clinch the argument. On an installation in a store, the order for which was closed recently, the proprietor was somewhat taken aback by the claims I brought to his notice, on what gas could do for him in giving him more and better illumination than he could secure with the tungsten lamps he proposed to use. The first costs were about equal; the gas fixtures, if anything, had the better appearance, and he was giving the proposition a somewhat serious attention, when the final question arose, what is this going to cost me per hour to run—12 inverted burners with gas at 80 cents; 2.9 cents per hour – $29 per 1,000 hours, or 12 — 60-watt tungsten lamps at 12 cents per kw. at 8.6 cents per hour, or $86 per 1,000 hours ($29 to $86 - one-third the cost). The installation had received practically equal consideration from the standpoints of appearance, convenience and service; but, when maintenance costs were considered it was not necessary to dwell on the increased advantage of gas, because of the maintenance service which could be afforded to insure the higher efficiency over that of tungsten. Glassware and accessories cleaned regularly insured an increase in average illumination of 20 to 30 per cent. over the electric, even assuming the initial installation of each to be on a par at the start. Those familiar with electric incandescent lamps and glass reflectors acknowledge these percentage losses where cleaning and washing are not regularly attended to.

Do not exaggerate the advantages of gas illumination. You don't have to, and I would much rather sell gas with a liberal discount of its fitness and illumination possibilities, than describe it fully and exactly. A customer who feels that his purchase is better than he anticipated will do more for you and go farther out of his way to get or give more business to you than one who may have been strongly canvassed and had his enthusiasm brought to a white-heat point. To illustrate this point I might quote from an English advertisement I answered about 10 years ago for a burner:

"An absolutely perfect light at last. The new 'Sun' incandescent gas light. Guaranteed to produce a greater and more brilliant light for a given expenditure than any other light in existence. No mantle —No chimney—No smell—No smoke—No danger. *Pearson's Weekly* says, 'It affords 6 times the light of an ordinary burner with the same consumption of gas.' It cannot possibly get out of order, will last a lifetime and saves its cost every month."

After a month of enthusiastic anticipation the burner arrived and was delivered. I was not discouraged because of the extra express charges, customs brokerage and duties I was called upon to pay, but rather looked forward with greater zest to the results of my purchase. I took it home, read the directions carefully and went upstairs to try it out. I at once realized its shortcomings. The burner consisted practically of a small brass vessel holding about ½ pint of paraffine; this was attached to a 2-foot Bray burner in such a manner that a wick from the tank could be turned up into the gas flame. Of course, a good, rich, high candle power flame resulted, but with a mind picture of the work necessary to keep that vessel full of oil it was not hard to overlook the main advantages claimed—a consumption of 2 feet of gas per hour. I had not exactly been gold-bricked, as on reference to the advertising and the write-up accompanying the package, I could not find any misrepresentation or untruth; the entire truth had not been given, however, and although this incident happened over 10 years ago, I have a very distinct recollection of my experience. We want our goods to say more for themselves than we do, to have a customer feel that he is getting not only his money's worth, but more.

How many gas men to-day feel that they have the electrical interests on the defensive? They have—almost—although the day is fast approaching when the electrical interests will cease to quote cost comparisons and depend altogether on the representations of how much they can give for $1, how much useful illumination, how much convenience, how much satisfactory, troubleless, complaint-proof service. It is "up to" the gas man to nip this canvass in the bud.

The thousands of places which can be illuminated satisfactorily with mantle burners are going to wait just a little while longer, until the tungsten lamp manufacturers catch up with the demand and perfect their product, or you get out and properly equip them with the right burner in the right place, installed in such a manner that the order will be a repeater and not a clincher for the electrical interests' arguments and talking points.

You have a good thing, but merit as an advertising agent is slow, too slow for to-day. You must tell about it. You must put up your "front." If you have not confidence in your product you cannot expect your customer to enthuse. In the "New Business Report, 1909," of the National Commercial Gas Association, I noted that 45 pages were given over to industrial fuel gas and 8½ pages to gas lighting. This was out of 136 pages, total.

You have to go after the business in such a way that your competitor is left without a leg to stand on—he must be brought to a realizing sense of your importance in the lighting field.

A paper on the "Luminosity of Gas Flames" was recently given before one of the Sections of the Illuminating Engineering Society. This Section's membership is largely electrical and I think they were somewhat surprised to find that a gas paper could contain so much, judging by the time taken to read it, which was so deep, was scientific, and yet did not contain a single mention of volts, amperes or watts. The average electrician knows that gas costs $1 per 1,000, is a convenience in a gas range and a hot competitor in light, "hot" referring more especially to temperature.

You must command respect, first, then show your man how you can give him more of a better product for a mere consideration to what he would have to put up with in electricity. Understand, I don't mean that electricity will not do all or as much in illumination as gas, but electricity is not furnished on any such a liberal basis. Electric service has not been gauged by what a man should have or would like to use, but rather by what he thinks he can afford to pay for in watt hours. This is no small amount. Do you realize how much gas, how many burners, how much of that main ingredient (I. & M.), inspection, maintenance and attention you could afford to give him for that amount? Does he know that you could give him a standard of illumination which would be so satisfactory that eclectricity would have to be sold at about 4 cents instead of 10 to 20 cents, as it is still in many parts of this country? With electricity at 10 cents, which is quoted as an average price, your gas is worth $2.50 per 1,000 cubic feet on the basis of effective illumination.

If a competitor does something better than you do, get into the bandwagon and do the thing as well, or better, than he does it. It is better to climb into the car of progress than to stand in its way. In proportion as you increase the value you give for a dollar, just so will you find it easier to get the dollar. The electrical interests have always been on the defensive; but a short time ago they were telling us that, with electricity at 10 cents a unit, they were on an equal basis to gas at $1 per 1,000.

Do the general public know that the comparison was made against a 5-foot, flat-flame burner, and a 16-candle power incandescent lamp? Having this point thoroughly grounded, is it now any wonder that many people believe that, with tungsten lamps, gas is on the toboggan-slide so far as all competition in price is concerned?

The consumer who has had the questionable experience of cheap mantle burners purchased from a department store, and attached without any special attention to outlet arrangement, distribution of light, character of glassware, pressure, adjustments, or the purpose for which the light source was required, is not the man who can give you the best reference. How often have we seen inverted burners used for lighting long, narrow corridors, where upright burners would give a better distribution; or placed on low brackets on the side of a large room, when upright mantle burners with artistic glassware, if attached to the central fixture where they would be in entire harmony with the general treatment of the room, would present to the eye a pleasing and satisfactory arrangement.

It would appear that the "duty" to-day is to be performed by the illuminating engineer. It is he who can best serve as your representative with the consumer, who can help you to lift gas to a higher plane, to a point more above the competition line.

While there are occasions where the gas and electrical interests in a city are not in competition, this is seldom true of these methods of illumination. There we have competition, but it would appear from trade literature and sales argument that the electrical interests have everything with them but the single item of cost, and that they claim to have met with tungsten lamps, scientific accessories and illuminating engineering. To a limited extent only is that true, where you compare an electric installation of high efficiency with one of gas of the lowest efficiency.

The science of illuminating engineering consists of the bringing together, the organizing and tabulating of various conditions having a bearing on illumination. A definition as broad as it is simple, or complex as you may view it, was recently given by a man who had some knowledge of the conditions, to a man who had never heard of illuminating engineering. In reply to the question, "What is illuminating engineering?" he answered, "You know what engineering is;"

Yes? "And what illuminating means," Yes? "Well put them together and you have illuminating engineering."

Illuminating engineering to the gas companies means satisfactory sales and an ever-increasing business; to manufacturers of accessories, it means sales by the dozens and hundreds where formerly some sales required special attention and a high standard of salesmanship to sell a single piece. To those employed it means better positions and more chances for advancement. To the public it means a higher and better standard of illumination, 100 cents for $1.

The illuminating engineer should be a vast help to the well-managed gas company. It is he who brings in the individual touch between the company and the consumer. It is he who gives that personality which is an important element in all business transactions, and which I believe means much in the matter of the securing and retaining of profitable relations. The electric business has in the greater part of the field been sold, and is a commodity requiring skilful and constant attention to insure its continued sale. I am speaking of the bulk of the profitable business, the other kind can usually be left to take care of itself.

Fig. 1 shows two accessories for the modification and distribution of light. The one on the left is a pagoda lantern in metal, with a straw, opalescent cylinder; that on the right is a prismatic distributing reflector, designed for an 8-candle power, carbon filament lamp, and used considerably a few years ago, prior to the coming of the metallized filament and metal filament high efficiency lamps. Should we depend on our judgment on the question of efficiency, the lantern would be at once condemned. Undoubtedly it is more artistic than the prismatic reflector, although the effect of the latter is not bad, as may be seen in Fig. 2.

Fig. 1.

Fig. 2.

In changing this installation the units shown in Fig. 1 were substituted for each other. Fig. 3 shows the light distribution of the lantern on the left and the prismatic shade on the right. The characteristics of each are surprisingly similar. The mean lower hemispherical candle power of the prismatic reflector is 16.84, with a 16 candle power carbon filament clear lamp, that of the lantern, 11.25, or ⅔ of the prismatic. The mean lower hemispherical candle power of the prismatic with an 8-candle power lamp is 8.05 or 71½ per cent. of that of the lantern with a 16-candle power lamp, and 48 per cent. of that given with the same shade and a 16-candle power lamp.

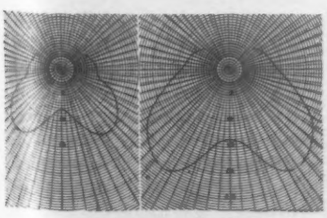


Fig. 3.

This shows that equal illumination can be secured by a substitution and use of one 16-candle power lamp and two 8-candle power lamps, where formerly three 16-candle power lamps were used with the lanterns. This would require 71½ per cent. of the electricity formerly used for equal illumination, a saving of 28½ per cent. or the use of the same amounts as previously with a gain in illumination of nearly 50 per cent. With electricity at the average prices to-day, this matter of efficiency must be given considerable attention. The electricity costs on this installation carry a minimum of $125 per month, with a net rate of 6 cents per unit on amounts over the minimum.

Gas was tried on this floor, but while the illumination was satisfactory as was also the ventilation, reductions in the monthly bills did not materialize; apparently no one had thought to look up the electrical contract which carried this $125 minimum charge, which was effective even though the actual service did not amount to $10 per month at maximum rates.

The store shown in Fig. 4 is remarkably well and uniformly illuminated, and was in somewhat of a similar shape both as regards illumination and costs. By taking advantage of the Central Station Company's regulations and contract conditions, this consumer was allowed to use sufficient electricity to double the wattage on this floor, and install five 100-candle power, 250 watt lamps, in the rear shipping room where formerly gas was used exclusively. He also received $500 cash which you might consider as an additional bonus.

Fig. 4.

On this floor there was formerly installed in addition to forty-eight 16-candle power lamps on the fixtures, 2 gas arcs and 48 upright mantle burners. I might add that in changing the fixtures shown, about 5 feet of stem was cut off, bringing the fixtures close to the ceiling.

To come to what is perhaps the most important point to all of us, "Can gas illumination be made a subject of study and satisfactory, profitable engineering?" If I were to answer the question in a few words, I would without hesitation say yes, and add that I believe the gas situation offers more opportunities for good work than the electric.

More and better illumination can be given for $1 with gas than with electricity. With gas we are not pushed to the last limit by economy in its strictest dollar sense.

The owner of the restaurant shown in Fig. 2 parted slowly and reluctantly with his lanterns, because of the effect he secured with them, which was not possible with the higher efficiency accessories. With gas that floor could be lighted for about one-fifth of the electricity costs, and could consequently afford a more artistic treatment, even though the losses in the less efficient glassware should rise to 50 per cent.

While we have been given photometric curves of thousands of electrical combinations, which condition contributes, by-the-way, to the enormous sale of scientific accessories, comparatively little has been furnished by the gas interests.

The curves in Fig. 5, I find, are somewhat of a surprise to many.

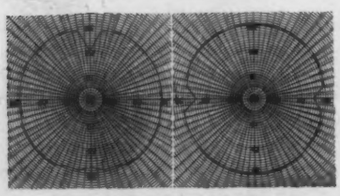


Fig. 5.

They represent the horizontal and vertical distribution of an ordinary flat open flame. The curve on the left is of the horizontal distribution, while that on the right shows the vertical. When we remember the care exercised to always turn the flat side of the flame towards the place requiring the greatest illumination, we realize how little was generally known about gas photometry and illumination. In Fig. 6, is shown 6 shades or reflectors ranging from the horizontal to 50°. Anyone of these can be made as easily and cheaply as confining the manufacture to any one particular angle. The variety of distributions afforded by the various angle shades can be seen on reference to Figs. 7 to 12, being the corresponding distribution curves for all the angles designated in Fig. 6 from the horizontal shade to that of 50°. These distributions are especially desirable for show window and gallery lighting; they also have a special application in bowling alleys and where certain localized illumination is desired.

Fig. 6.

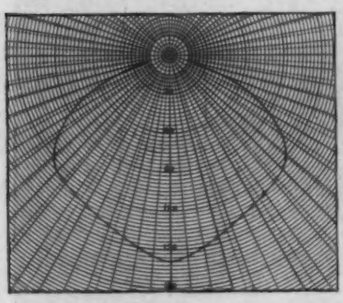


Fig. 7.

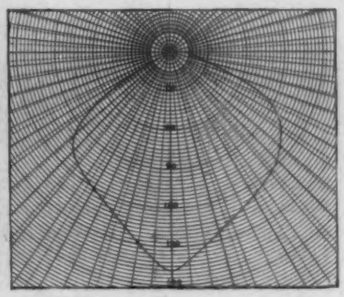


Fig. 8.

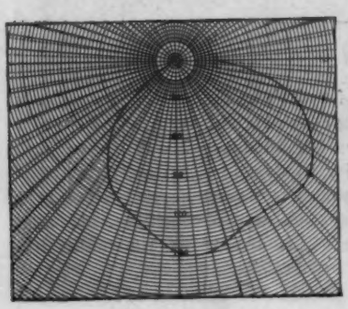


Fig. 9.

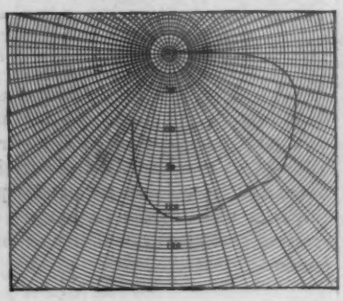


Fig. 10.

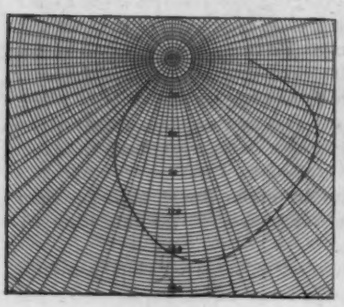


Fig. 11.

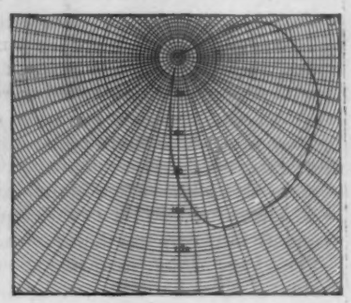


Fig. 12.

Windows can be most satisfactorily illuminated as shown in Fig. 13, the height and depth being the factors determining the proper degree angle reflector to use. The question of intensity required, which is entirely governed by local conditions both as to costs and the question of what competitors are doing, is taken care of by the total quantity of light introduced, the number of lamps and their spacing. On Fig. 14 is shown how we can use the distribution from

Fig. 13.

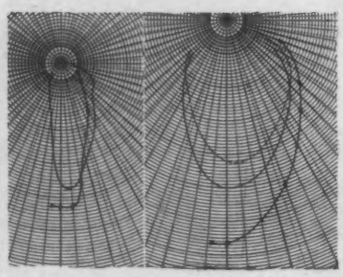


Fig. 14.

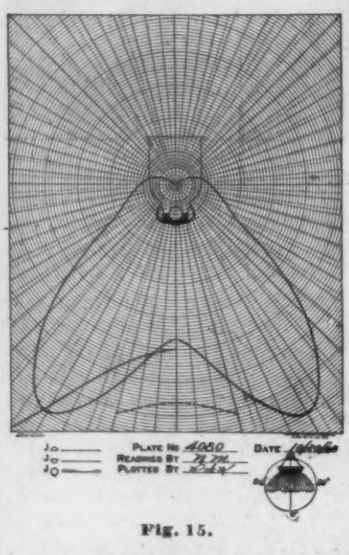


Fig. 15.

angle reflectors in various sized show windows. The curves designated by the crossed lines are for windows of widely different character, that on the left being a window 7 feet high and 18 inches deep. The plain line curve is the distribution of the source which met the specification. The curves on the right are for a deeper window, a window 8 feet high by 7 feet deep.

Fig. 15 shows the modification effected by the simple frosting of the bottom of the cylinder. This distribution is of an inverted burner equipped with a prismatic reflector, the dotted line showing the end on intensity when this source is equipped with a clear cylinder. The curve running from the center of the plate to the lower corner is the theoretical curve for uniform illumination at a height of 10 feet. This change in end on candle power from 133 to 94 makes a difference in the mean lower hemispherical candle power of 71.1 to, 70.3 or just over 1 per cent., which, considering the increased advantage, is a very small tribute to pay for the more favorable distribution secured. For efficiency comparisons I believe all are agreed that mean spherical or mean hemispherical values are the most important factors for con-

sideration. The flux-polar diagram, Fig. 15, has been adopted by many engineers and renders the securing of comparisons a matter of 10 readings on the dotted line intersection of the distribution curve, an addition, and the placing of a decimal point. Fig. 16 shows the

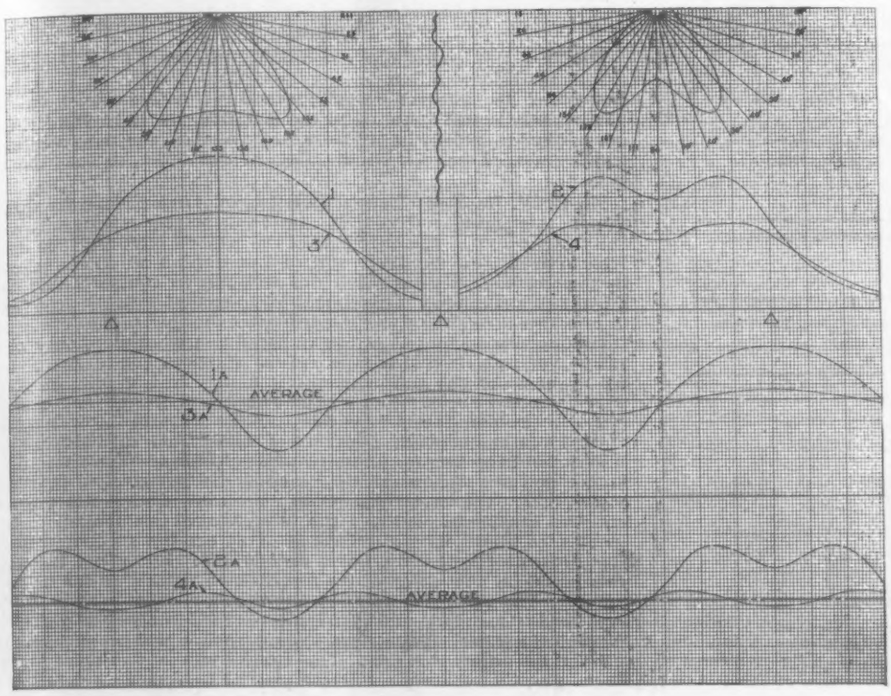


Fig. 16.

resultant curves; first, the photometric distribution curves at the top of two inverted burners equipped with prismatic distributing reflectors.

The one on the left is with a clear cylinder, while that on the right is a duplicate of Fig. 15, the one using a frosted bottom cylinder. Curve No. 1 is the resultant illumination on a plane 8 feet below the light source for a distance of 12 feet from the foot of the perpendicular. Curve No. 3 is on a similar plane 10 feet below the source. Curves No. 2 and No. 4 are under similar height and distance conditions to No. 1 and No. 3. The lower curves are from a line of units placed 18 feet apart, and are plotted from the values shown by the individual curves, Nos. 1, 3, 2 and 4, showing graphically the effect of various heights for the distances assumed. The straight broken line in each case represents the average values for curves 3*A* and 4*A*.

It will be noted how much more uniform the distributions with the 10-foot heights are than those of the 8-foot heights. With the clear cylinder at the latter height, 8 feet, the maximum is 128 per cent. of the mean, the minimum is 47 per cent. of the mean, and 36.7 per cent. of the maximum. Maximum is 2.15-foot candles, minimum .79-foot candles, and mean 1 68-foot candles. For the same conditions with the frosted cylinder, these percentages become 125 per cent., 60.5 per cent and 48.4 per cent., and the values 1.84, .89 and 1.47. At the 10-foot height with the clear cylinder the maximum is 1.43 foot candles, minimum 1.12, and the average 1.3 foot candles, the percentages being 110 per cent., 86 per cent. and 79 per cent. With the frosted cylinder at this height, we get a more uniform distribution 1.23 foot candles, 1.05 and 1.13 foot candles, or in percentages 109 per per cent., 93 per cent. and 85 per cent. This, compared with the clear cylinder under the 8-foot height condition, is maximum 109 per cent. and 128 per cent. of mean, minimum 93 per cent. and 47 per cent. of mean, minimum 85 per cent. and 36.7 per cent. of maximum respectively. The purpose of these curves and somewhat technical matter, is to show that gas illumination can be handled just as readily and satisfactorily as electric. The laying out of the installation shown in Fig. 17, was handled by an engineer who had practically no experience with gas up to that time. He was given a polar distribution curve of the unit to be used, a plan of the floor and detail of the ceiling and outlet arrangements, and an outline specification covering the requirements. That the resultant illumination is good can be seen by the photograph of the floor, and on Fig. 18 we have a floor plan showing the outlets and skylight, also the lines on which the measurements of illumination were made with a Sharp-Millar illuminator. These measurements were made some time after the completion of the installation. On the lines *A-B*, *C-D*, *E-F* and *G-H*, we have average intensities of 3.81-4.02-3.01-2.02 foot candles which you note is very uniform on the lines mentioned. The curves *E-F* and *G-H* exhibit the same characteristics as the calculated values shown on Fig. 16, for the frosted bottom cylinder at 10 feet height curve 4*A*.

Fig. 19 shows a plan of a tailor's draughting table 7 feet by 14 feet arranged for 3 draughtsmen. The working space of each operator is shown within the double lines. This plane 22 inches by 6 feet is uniformly illuminated with an average intensity of over 4-foot candles with a variation from maximum or minimum to mean of less than 10 per cent. This is a variation considerably less than is observable to the eye.

The arrangement of the three inverted burners at a height of 5 feet 8 inches above the table and with a spread of 4 feet 8 inches *A* to *B*, and 7 feet 7 inches to *C*, is not quite that which is usual from the standpoint of a gasfitter. The objects to be secured were uniformity of distribution of a sufficiently high intensity, and a direction of light which would insure the breaking of all shadows from the squares and draughting instruments used.

The shaded curves show the resultant values as measured with an illuminometer. This table has been in use several months, and the artificial illumination has been stated to be more satisfactory than the natural light (daylight) received from a large window on the right hand end of the table.

The draughtsmen working here were accustomed to using electric lamps in green cone shades, but find this arrangement much more satisfactory and the costs (1 cent per hour) are equivalent to the use of one 16-candle power and one 8-candle power lamp, which would not be sufficient to properly and equally illuminate one-fifth the area covered so satisfactorily by the three inverted burners. After all, when we look over the fieid, we realize how little has been done and how much is still to be accomplished. The surface has not been more than scratched.

Fig. 17.

Little has been said in the past about candle power depreciation in mantles and I have some figures here which were secured from tests of mantles of medium good quality. The efficiency from the initial to 100 hours shows a drop of 11 per cent.; at 250 hours, 12.8 per cent.; at 500 hours, 27.2 per cent.; and at 1,000 hours, 33 per cent. This, by-the-way, is not greater than the depreciation in electric lamps by dust alone. Mantles from similar stock, when subjected to tests on a bumping machine, withstood an average of 1,191 bumps.

It would undoubtedly be a valuable addition to get illumination if we could have mantles which were specially made to hold their candle power as well as their ability to withstand shock. The day is now nearer than ever before when gas companies will demand just such a mantle. From the standpoint of selling gas by the candle foot a mantle which would stand up and give a fairly long life was not asked to hold up in candle power.

When it comes to selling illumination, however, it is necessary that the candle power depreciation be known and be considered. I can state that we can shortly look for mantles which can be guaranteed to not exceed a drop of 3 per cent. in efficiency in 1,000 hours or 10

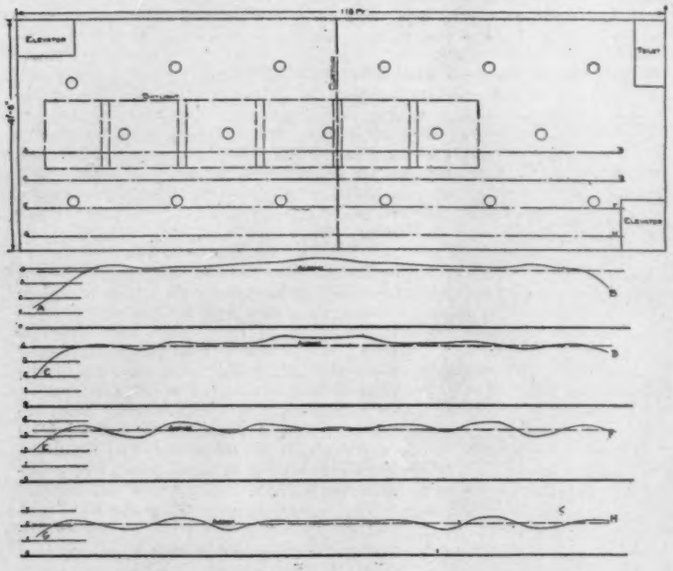


Fig. 18.

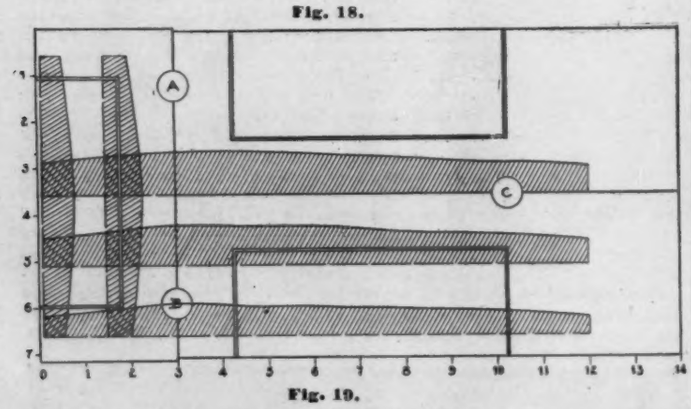


Fig. 19.

per cent. in even 4,000 hours. Tests have been made and these results have been secured.

The electrical interests welcomed the tungsten lamp and expensive accessories to enable them to meet the competition of the ordinary, none too efficient, upright mantle gas arc. They have even gone farther and in many instances have scrapped their electric arc lamps. Note the large store on Washington street in this city, where over 80 arc lamps were removed and tungsten lamps substituted to enable a reduction to be secured in the bills and more satisfactory service to be rendered to their consumer. The consulting illuminating engineer on this work was retained by the central station company supplying the service.

On the maintenance proposition the gas companies have a condition which can be turned to their distinct advantage. Through this service you can better keep in touch with your consumers and sell illumination. As an illustration of what this new kind of service means I might call attention to a city where we are somewhat familiar with the conditions. The old gas company had the field. The electric company was supplying lamps, both arc and incandescent, to its consumers, the only charge being that for current. This forced the gas company to supply 4 mantle arcs and free maintenance. About the 1st of last July new interests took over a competing gas company which, having failed to make good, was forced into a change in management.

The new interests believing that the people would recognize the difference between purchasing gas, at so much per 1,000, and illumination, selected the most efficient and scientific equipment known in the industry, not confining themselves to the conventional upright mantle gas arc.

The result: They have not only succeeded in putting the electric company very much on the defensive and cut into their revenue considerably, but have proven that illumination with gas at 90 cents per 1,000 is a proposition meeting with greater success and more favor than obsolete arcs with gas at 50 cents per 1,000. The latter, being the point to which the old company has reduced its product in the mistaken idea that it is still selling gas and have little interest in its ultimate result—illumination. The placing of over 10,000 efficient inverted burners in the short period—July and October—many of them in positions and places where a gas arc of any kind could not possibly have been used; that is to say, in direct competition with small electric incandescent units. The additional gas sold, together with the well-laid foundation for the sale of more gas, is an achievement which cannot be measured nor estimated, either by the number of burners put out or the present consumption of gas.

(To be Continued.)

[Continued from page 881.]

PROCEEDINGS, FIFTH ANNUAL MEETING, ILLINOIS GAS ASSOCIATION.

HELD IN CHICAGO, ILLS., MARCH 17TH AND 18TH, 1909.

FIRST DAY—AFTERNOON SESSION.

Discussion.

The President invited discussion on the papers as ["An Investigation of the Effects of Compression and Transmission on the Candle Power and Heat Units of Manufactured Gas"] before you. He wished particularly to call attention to the fact that Mr. Bates and Mr. Cole deserve equal credit with those who have read the papers in their preparation. I will ask Mr. Bradley, of Oak Park, to start the discussion.

Mr. C. W. Bradley—There does not seem much chance for discussion on this paper, as the results are from actual experiments carefully carried out. The only part of the paper I have any data on relates to the drop in candle power. I do not think we should take the large percentage of drop given too seriously in contemplating high pressure distribution. This should be compared with the drop found in low pressure systems and the difference charged to the detrimental effect of compression. Age and transmission of any ordinary water gas will cause a drop in candle power. Suppose you make a 23-candle power water gas and distribute it under the low pressure 3 or 4 miles from the works. You will have a loss of from 2½ to 3 candles, and deliver about 20-candle power gas. To compare this with a compressed gas transmitted, I had some tests taken in February and March, 1907, the average of which was as follows: Works test, 23.89-candle power; testing station, 19.12-candle power; loss in candle power, 3.77. The testing station was 11 miles distant and the pressure was 18 pounds. Now, if the low pressure distribution costs 2½ candles we would have a difference of 1½ candles to charge to the high pressure distribution, not a serious loss. Recently I had some tests made on the effect of compression on candle power up to 30 pounds. The work was done by Mr. Clark, chemist for the Northwestern Gas Company, and the results checked fairly close with those given in the paper. The special feature was we used the same sample through the different stages. The candle power was taken on the works gas, then a sample was compressed to 5 pounds in a 6-inch pipe and tested. The remainder of the sample was compressed to 10 pounds, in a shorter pipe, and tested; and, so on, up to 30 pounds. There was no drip to speak of; and the loss in these tests showed from 9.49 per cent. to 21.31 per cent. The curves from these tests show the heavy loss starts after the 5 pounds pressure. A reason for the higher candle gas standing better under compression is the heat under which the gas is made. Mr. Clark watched the heats on the machine making the gas, and in every case where they were low a heavier loss was sustained. To make a higher candle power gas the heats are generally raised, the gas is better fixed, and it will be transmitted by either system with less loss.

Mr. Goodnow—These papers are certainly a great credit to the young men who have labored long and industriously in making the determinations, and they are steps in the direction to which gas engineers have been looking ever since high pressure distribution was attempted, which in their district goes back about 8 or 9 years. It was probably as good a place as could be found, with the different lines of transmission here to make these experiments, as any other place in the country. An English engineer, from a prominent firm in London, visited this region last summer, and, to use his expression, "The region around Chicago had the largest clot of high pressure pipes and systems of any place in the world." Therefore, it was a particularly good place to make these determinations. I think when they are carried out to a greater extent and with greater accuracy, which only can be done with time and painstaking labor, we will arrive at some very valuable conclusions. These latter are exceedingly valuable as they are, for while they have confirmed some opinions, they have also changed some opinions that we formerly had; and I think it is quite likely they will be again changed before we arrive at accurate data. The most happy result I think these papers have shown, is the surprisingly small decrease in British thermal units after compression and transmission. A study of the tables will show this, and I am free to confess they are much less than I expected to see. Starting with a gas of whichever kind, of say 625 units to the cubic foot and losing about 15 to 25 units or so, after being transmitted from 8 to 22 miles, is certainly a good record to go before our customers, showing that this method has not greatly damaged the gas from the heating value standpoint. Of course, it is generally acknowledged that that is the test of gas, and the candle power loss is of comparatively small importance. The tables shown in the first part of this paper, in which greater loss is shown, in both heat units and candle power, above 60 pounds than under 60 pounds, do not particularly interest us, except from a theoretical point of view, as our transmission is generally a good deal under 60 pounds at the initial point. I have observed in California, where there is a method, with which probably most of you are familiar, of compressing in tanks to perhaps 60 to 100 pounds, and then reducing and transmitting from these high pressure tanks. This practice seems to me, from an engineering standpoint, unnecessary and expensive, and, as these determinations have shown, is more damaging to the product than the lower compression which is necessary to send the gas for any reasonable distance, perhaps up to 30 miles, even with comparatively small pipes. The tables also confirm the working observations that the gas compressed to 10 or 20 pounds shows almost no deterioration

in British thermal units, proving that, in actual working conditions, 10 or 20 pounds show very little damage to the gas from either kind of analysis; and, as observed by Mr. Bradley, is comparatively little greater than it would be by the ordinary low pressure transmission. It is also observed in the actual working, that scarcely any trouble is occasioned by naphthaline after the gas has been compressed 20 or 30 pounds. These determinations bear that out somewhat by the analysis of the condensate, as shown, although that approximation was not definite enough to exactly show what those constituents are, but an oil deposit of somewhere about 80° specific gravity, and consequently were valuable illuminants, which is shown by the decrease in candle power. The observations also of condensation of water vapor at 20 or 30 pounds pressure accounts a great deal for the freedom from frost in our services and transmission lines in the winter, which, at working stations, of course, we have known for several years. The transmission up to 22 miles demonstrates why we have observed some things in the actual working, and explain things which were somewhat confusing to us before. The whole series of determinations opens up a desire to see these determinations extended and elaborated, and I trust that the same work can be extended and more elaborate tests completed.

Mr. R. B. Harper—I think the papers have opened up a thoroughly interesting scheme of investigation. I believe the work should be continued in order to arrive at some very valuable and practical data. I think the fact that these experiments were made at various times and in various sections has a very important bearing on the results; that is, as our ground temperature varied from time to time, it seems to me this is a very important factor in determining our candle power loss. There is no especial point in either paper which I feel that I could extemporaneously discuss. I agree with both of them on the main points.

The President—Is there any further discussion on this paper?

Mr. C. W. Bradley—I might add that, as far as condensation is concerned, we have a line 40 miles in length. We went down in it 12 miles from the starting point and never got a drop of water of any description. It all dropped out in 12 miles of transmission. We just got a trace of it at 12 miles, but beyond that not a bit of vapor is left in the gas at an ordinary temperature, no matter how cold it is in the ground or what it passes through.

The President—If there is no further discussion I will ask Mr. Houghton to reply first, and his reply may include any discussion of part one.

Mr. V. A. Houghton—Mr. Bradley's point was correct; namely, that ageing and compression will deteriorate gas. I do not quite understand the object of using different sizes of pipe for different stages of compression, however. With reference to part one of the paper, there has been some work done alone this line prior to now by German engineers, and I found some valuable figures with reference to it in the Proceedings of both the American Gas Institute and those of the Ohio Gas Light Association. The statement was made that, should a volume of gas be compressed from 10 to 20 pounds, the vapor content would be cut in two. I do not quite agree with that. I think you should refer to the absolute pressure, not the gauge pressure For instance, consider a volume of gas at atmospheric pressure with a quantity of vapors contained therein; if this is compressed to 15 pounds, thereby doubling the absolute pressure, you have cut the quantity of vapor present in two, and also the volume. I think, as I said before, we should refer to the absolute pressure and not the gauge pressure. Another point, too, I have in mind is this. It seems to me in work of this kind, more attention should be paid to the saturation temperature. For instance, if you have 24-candle power gas, which is saturated with hydrocarbon vapors at 70°, and this gas is compressed, it will not compare with 24-candle power gas which has been saturated, say, at 40°. In other words, if there be a drop of 30° in temperature between the holder and the photometer room in one case and not in another, a different result will be obtained. I do not believe that the considerations of the degree of saturation of the gas with vapors can be emphasized too strongly. It is quite true that compression will probably not affect the fixed gases to any great extent, because it has been clearly laid down that the work was carried on above the critical pressures, but where vapors are dealt with which can be condensed, very strict attention must be paid to that point. I believe that is all I have to say in reply.

The President—I will call on Mr. Rafferty for a reply, and ask him to also include in his reply any discussion he may desire of Part II. of this paper. Inasmuch as stress has been laid by Mr. Houghton and other speakers on the saturation temperature, I would like to ask Mr. Rafferty, if possible, to tell us what he can as to the saturation temperature, or previous history, as we might say, of the various samples of gas that he tested. In other words, whether these various samples of gas came to the testing room, having previously been subjected to about the same minimum temperature at all times, or if not, what the variation was? That would be in answer to the point Mr. Houghton just brought out, that if you take a sample of gas from the pipes in the ground, which sample has been cooled to 60°, and you compress that and cool it to 60°, for instance, and the next day your sample had been cooled in the ground to 40° or 50°, and you then compressed that and cooled it to 60°, would you not obtain a different result, due, not to the compression, but to the previous treatment of the low pressure gas?

Mr. Rafferty—I would like to say, in reply to the President, that we did not take the dewpoint of the gas before we compressed it. We started our tests and the question of dewpoint was not brought to us forcibly enough until it was too late to go back. However, our curves indicate that we obtained the saturation point of the hydrocarbon vapors at a very low pressure. Tests were made on an 8-inch wrought iron, high pressure line, between 96th and 73d streets. This line is 5¼ miles in length. A compressor at 96th street compressed the gas to 10 pounds pressure at 96th street. The tests lasted 2 days, and each hour the composition of the gas, its temperature and candle power, before entering and after leaving the compressor, and the heat value before entering the compressor, were obtained at 96th street. At 73d street, gas analysis, candle power and heat value were obtained. On the first day the average pressure at 96th street was 7 pounds. This day the drop in lighting power, between 96th and 73d streets, was near 3.25 candles, and the drop in heat value about 6 B.T.U. On the second day, when the pressure was 10 pounds, we obtained a drop of 4 candles and 8 B.T.U. between 96th and 73d streets. The small drop obtained in heat value was emphasized by Mr. Goodnow. The point brought out by Mr. Houghton, that we should have spoken of absolute pressure instead of gauge pressure, is a matter which we should have brought out more clearly. We intended that this pressure should be considered as absolute pressure. We made it 10 pounds, so as to make it easy for the members to figure out our partial pressure. We did it more for convenience than anything else, but it is supposed to be absolute pressure. As to Mr. Bradley's comment that it might be better to account for a larger drop with a 21-candle power gas than with a 24-candle power gas, from the standpoint of fixing the gas, while we cannot arbitrarily say that our point of view is better, it seems to me a 21-candle power gas can be just as well fixed as a 24-candle power gas, but that the composition of the two may be different, or the quantity of illuminants may be more in the latter. Not knowiug what conditions obtained when the gas was made, we took up the other point of view which seemed thoroughly reasonable. The difference in temperature between the inlet and the outlet of the compressor at 96th street was about 60°. The candle power of the gas before it went into the compressor was the same as when it left the compressor. The gas was raised 60° and the vapor pressure of the hydrocarbons was thereby increased. If the temperature of the gas was the same at both the inlet and the outlet of the compressor, results similar to ours probably would have been obtained. In other words, the mixture of hydrocarbon vapors would have a vapor pressure less than that sufficient to sustain the pressure put upon them, and condensation would follow up to a point where they attained a vapor pressure able to do so. When the gas left the works, of course, the temperature of the gas was reduced to that of the ground, which was about 36°. This reduction in temperature was accompanied by a lowering of the vapor pressure of the hydrocarbon vapors, and it required less pressure to liquefy some of them at this temperature than it would have at the temperature of the inlet or outlet of the compressor. Messrs. Houghton and Cole obtained the lowest temperature to which the gas had been cooled by means of the hygrometer. The gas was then compressed to 30 pounds, passed through a regulator, then through a cooling coil which cooled the gas down to that indicated by the hygrometer. By this treatment no candle power drop was obtained. The reason for this is that when the gas was compressed its temperature, and consequently the vapor pressures of the hydrocarbon vapors, were raised to such an extent that no condensation took place, a state of affairs similar to that at 96th street. When the gas was passed into the regulator it expanded immediately and tended to regain its original condition of temperature and volume. It was then cooled in the cooling coil to the same conditions as those under which it existed at its saturation point, and in order to get a drop in candle power the gas would have to be cooled below the dewpoint temperature, as indicated by the hygrometer. By so doing we would have increased the partial pressure of the hydrocarbon vapors over their vapor pressure, thereby putting them out of equilibrium with the pressure upon them and causing condensation.

The President—This combined paper will be presented to the Institute as a portion of our research contribution for their further action. I am sure I voice the sentiment of all the members present in extending the thanks of the Association to the four gentlemen who have done so much good work for the Association in this paper.

(To be Continued.)

Special English Correspondence.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, May 10th, 1909.

Tar as a Dust Preventative—Suction Gas versus Town Gas—Small Gas Engines.

With the advent of a genial outdoor atmosphere and bright sunshine, the nuisance caused on our main roads by the dust raised from the wheels of motor cars, once more becomes apparent. The actual effects are best seen from a hill commanding stretches of some miles of main roads, when the white cloud raised by a passing car, extending more than a mile in length, is discernible at a distance so great that the disturbing cause is barely visible. The various methods of applying tar to the surface of roads now attract much attention, particularly as it is an established fact, that when applied with reasonable skill and some knowledge of the properties of the fluid used, it is an unqualified success, not merely as a dust preventative, but as a source of economy in connection with the repair and upkeep of the public roads. So much is evident when we remember that the white cloud, just referred to, consists of valuable binding material sucked out from the immediate top surface of the road by the pneumatic tire. The necessity for knowledge and skill in its application is

emphasized, because the same mistake is being made this spring that was the cause of so much trouble and annoyance last year. Borough surveyors, contractors, and others actually responsible for carrying out operations, appear to conclude that the first fine day of the year is the right time for the work, or are urged on to it by impatient complaints, whereas several days of warm sunshine are necessary to insure a proper condition of the road surface. In 1908 there was a heavy fall of snow over a large area of the country during the last week of April, with the result that the road surface was thoroughly chilled and saturated by moisture when the thaw came. But the snow had scarcely disappeared before the tar sprinklers commenced their operations. As might be anticipated, the tar did not penetrate or dry as it would do under proper conditions, wheels of bicycles and motors were coated, instead of the road, with very unsatisfactory results, and wet tar tracks were to be seen on the footwalks and in shops, offices, etc. All this annoyance could have been prevented, and a much better job made, by waiting for at least a fortnight of sunshine. There has not been a snow storm this year, but the roads are cold after a long spell of frost, and yet with the first fine day out comes the tar sprinklers. Passing through the chief thoroughfares of one of our largest provincial cities a few days ago, I saw a repetition of the troubles just mentioned. Tar was being spread upon surfaces not sufficiently dry and warm to receive it, and no attempt was being made to control the traffic, the idea apparently being that a sprinkling of sand was all that was necessary to render the road fit for immediate traffic of all kinds. A better plan is to do half the road at a time, and to keep the traffic off for at least 12 hours, some judgment being exercised in the direction of selecting a slack day for the operation, so as to avoid or at least to minimize interference with business. If these points receive proper attention, the use of tar on roads will become general, but otherwise it is likely to be regarded by the public as a remedy worse than the disease. Probably I shall be reminded here of the old story about the barbarism of applying a fluid containing dyes and other constituents worth much more than their weight in gold. But it is a curious anomaly that the greater the number of valuables recoverable from tar the less is its intrinsic value to the maker. The already long list of tar extracts is extended year by year—and the price offered to gas companies as steadily dwindles. It will soon be a choice between using the tar for road and asphalt making or giving it away.

The new National Budget just being introduced proposes a heavy tax on automobiles and on petrol, with some revision where the vehicles are used entirely for trade purposes. But as a partial comfort it is stated that a part of the proceeds are to be devoted to improvement of our main roads. A high authority has stated that from an engineering point of view a complete prevention of dust is perfectly practicable, and that the only problem is one of cost. This should mean a better outlet for the use of surplus tar than the only one at present available.

Perhaps there is no business that takes less notice of the efforts of its competitors than the gas industry. Under the sense of security developed by steady and uninterrupted increase in sales, that is the usual experience in every gas works within the recollection of the oldest inhabitant, matters are allowed to pass unnoticed that would meet with considerable opposition in the case of less secure lines. One objectionable result of this supineness is that the competitors have waded bold and reckless, and do not hesitate to make statements that would first receive greater care and consideration if assured of careful examination in the opposition camp. Lack of experience in the way of any competition worth the name, that is, such as would make serious inroads into the annual sales, is also an advantage to the competitor, who finds less difficulty in making a position for himself than might otherwise be the case. Suction gas is an instance in point. The makers of this form of apparatus put forward large claims on the score of cheapness, and these have been accepted without question by many gas engineers. Suction gas is regarded as invincible, and the makers have been allowed a free walkover in the matter of securing power business. Mr. H. O'Connor recently delivered an informative discourse on the subject of Suction Gas Plants before the Scottish Junior Gas Association, the point of which was, that, given a fairly based plan of differential prices, much of the power business might be retained. Going fully into the composition of suction gas and comparing it with town gas, he showed that the latter offers several distinct advantanges in the matter of quality that under many circumstances are sufficient to cover any difference in the matter of price. One of these is the facility and certainty of ignition. Users of this make of plant do not hesitate to impose upon the local gas company, by having a full sized service and meter supplied, putting them to as much expense as would be required for a constant supply, when the real intention is only to use an insignificant quantity of town gas to assist in starting the engine. Suction gas is such weak stuff that frequently there is a difficulty in getting a start in the mornings. This abuse is becoming so prevalent as to direct the attention of gas suppliers to the need for some special arrangement in the case of stand-by supplies, especially in districts where meters are provided gratis. One method of meeting the difficulty is by a revision of the charges for meter rent, or the addition of a special charge in all cases where the consumption of gas is to a marked degree not of proportion to the size of the meter. Another disadvantage of combined supplies is that the suction gas plant is always under exhaust. If it is desired to change over at a time when there is a full draught on the town mains, say in the morning when all the cookers are in use or when the evening lighting consumption is in full swing, the opening of the town gas supply cock before closing the suction plant or before seeing that the exhaust is properly equalized throughout the supply pipes, may be disastrous to consumers in the neighborhood. In one instance of this kind a gas consumer of 50 years' standing said he never had a similar experience. "The gas jumped out in a moment, just like the electric light does." Mr. O'Connor mentioned that it had been claimed as an advantage of suction gas that it only contained two-fifths the proportion of hydrogen present in coal gas, and therefore would stand a higher degree of compression before exploding. But in practice this advantage belonged to the town gas, because neither gas was used neat, but diluted with its proper complement of air. While 1 cubic foot of suction gas would only require ¾ cubic foot of air, a similar quantity of coal gas required 5 cubic feet. The proportion of hydrogen in the mixture contained in the cylinder was less than 6 per cent. with suction gas, and 12 per cent. with town gas. Going into details of working, he showed that suction gas apparatus required frequent if not continual attention in order to secure satisfactory results, and that, except in the case of a large plant run continuously, the extra cost for labor might more than cover any saving secured by the adoption of the apparatus in place of the town gas. Sometimes, on account of irregularity in starting, it was found preferable to keep the apparatus going throughout meal hours, and this contingency did not enter into the makers' calculations of cost. He also feared that competition and a desire to show a cheap first cost had tended towards weak and flimsy construction, leading to a short working life and to frequent expenses for repairs.

In a discussion that followed the reading of the paper it was evident that suction gas was not without friends amongst the speakers. But the views expressed in the lecture received substantial support from practical experience. It is quite evident there are several points that should be brought to the notice of all possible or prospective users of this form of plant.

A suggestion has been recently advanced that the use of the small size gas engine, both for domestic and for technical use, has never been prospected as it should be. I refer to those of 1-man up to ¼-horse power, which may be used for driving sewing machines, boot or knife cleaning machinery, or running small machines at present driven by hand. The very large extent to which light oils are now applied to automobiles of every kind has attracted a great deal of attention to the construction of small gas engines, occupying as little space and weighing as little as may be practicable without sacrifice of strength or efficiency. A peep into the machinery box of any motor car is sufficient to illustrate the advance that has been made in this respect. A machine sufficiently powerful for the purposes just named would stand under a table or bench or at the corner of a shelf, and with the reliable supply afforded by a connection to the town gas main would prove economical in use and always ready at a moment's notice, with no loss of time in preparing for starting.

Items of Interest
FROM VARIOUS LOCALITIES.

It looks that Messrs. R. D. Wood & Co., of Philadelphia, must have somebody on the Coast recently, whose time was not spent there in vain. At any rate contracts for the construction of holders at the places named were recently awarded them: Pacific Coast Gas and Electric Company, 500,000 holder, at San Jose, Cal.; a holder up to retaining 150,000 cubic feet, for the Pacific Coast Gas and Electric Company, of Vallejo; and a 200,000 vessel to be erected at Bakersfield, Cal., to the order of the Power, Transit and Light Company. It is agreed upon that the three holders will be in operation on or before September first.

Mr. Arthur D. Little informs us that the business of the Laboratory of Engineering Chemistry, Boston, Mass., which was established there in 1886, has been incorporated under the name "Arthur D. Little, Inc." This was done in the belief that the facilities of the laboratory may be further extended and to secure permanency in its organization, the Company is prepared, through its large staff of specialists, to undertake any work involving the application of chemistry "to industry." The headquarters are in No. 93 Broad street, Boston.

Mr. E. M. Addis has been appointed Superintendent of the Brattleboro (Vt.) division of the electrical plant of the Twin State Gas and Electric Company, succeeding Mr. W. P. Fry, resigned.

President Cortelyou, of the Consolidated Gas Company, of New York, has been elected to succeed the late Calvin Paige on the Board of Directors, New York Mutual Gas Light Company.

The Milwaukee (Wis.) Gas Light Company has presented to every architect in that city a handsomely bound volume (large pocket edition), entitled "Bulletins and Data Relating to the Use of Gas." The issuance of the book, as one of the prominent newspapers of the city remarked over its appearance, is "significant of the attitude of such progressive concerns as the Company towards its customers.

The object of the book is to acquaint the builder of a home with the means of installing gas with least expense and bother." Perhaps the introductory chapter text explains the purpose of its compilers, which is thus lucidly set forth: "We present herewith, in compact, convenient form, information which we believe will be of value to you. As further progress is made along lines indicated, subsequent bulletins will be issued. In gas ranges, designed for small homes as you build for your clients, this book marks a decided advance. In artistic lighting equipments it presents combinations which will interest you."

WRITING about casual, rather occasional publications, of the nature above referred to, recalls to mind a splendid sample of such work recently put out by the meter manufacturing house of John J. Griffin & Co., of Philadelphia. It is in the nature of a handsome ¼ quarto (if we may so write), carrying 24 pages between its covers. It is a marvel of accurate, tasteful printing on beautiful paper, and each page has something on it that is sure to arrest the attention of the housekeeper. Of course, all its precepts are to the sustaining and spreading of the use of gas in the household, and elsewhere, for that matter. The covers are beautifully illuminated, and altogether it is quite up to the thoughts of its preparers—to be purchased by gas companies for distribution by them amongst the residents of their respective centers. Perhaps the best way to find out all about it, though, will be to write to Mr. Jno. J. Gribbel, at his headquarters in Philadelphia, for a copy of the pamphlet which bears the invigorating title of "Bottled Sunshine."

"THE Pulaski Gas Light Company, of Little Rock, Ark., spread a luncheon for business men, at its headquarters on Main street, 2 days during the first week of the month. The edibles handed to the guests gave the guests good knowledge of how successfully gas can be used for cooking. In the 2 days over 600 guests enjoyed the hospit ality of the Company.—V. M."

AT the annual meeting of the Milton (Pa.) Gas Company the Directors elected were: E. H. Heaton, M. A. Heinen, Sidney Davis, T. C. Heinen, R. M. Wilson and D. Hedenberg.

THE City Council of Grand Forks, N. D., has instructed the local assessors not to assess the Company's franchise for a twelvemonth.

"THE meter readers of the Denver (Col.) Gas and Electric Company are the fastest things in baseball; that is, teams whose members have to do other things than play baseball for a living. The hardest (supposedly) ones they had to meet were supposed to be in the make-up of the Denver White Sox team. The second Saturday this month the rivals met; but 'Sox' were soft; oh, so soft! Score, Readers, 7; Sox, 1.—R."

THE Canarsie Board of Trade (almost everyone in and near to Long Island, N. Y., knows that Canarsie is on Jamaica Bay, at a point midway of Long Beach and Coney Island) is anxiously awaiting the day when its inhabitants may have gas in their houses. We presume this service should come through the East New York branch of the Brooklyn Union Gas Company, but so far the latter has not shown any particular desire to put down the pipe—quite a bit of salt marsh intervenes. The demands, however, have been so persistently neglected that the Public Service Commission will be appealed to for an order directing the Company to extend its mains to the settlement named.

AT the annual meeting of the Chester (Pa.) Gas Company the officers elected were: Directors, S. A. Crozer, J. H. Roop, C. Bushong, D. H. Cloyd and E. B. Johnson; President and Treasurer, J. H. Roop; Secretary, A. B. Johnson.

THE Ithaca (N. Y.) Gas Company, through its Treasurer, Mr. William T. Morris, is before the authority, asking the right to issue a mortgage in the sum of $750,000, for furthering the material needs of the Associated Gas and Electric Companies, of which present concern Mr. Morris is the official executive head. The plan is, provided the necessary consent is obtained, to issue $240,000 of the bonds, of which $200,000 will be reserved to retire outstanding mortgage bonds, $27,490 will go to taking up floating debt, the balance ($12,000) to be used on plant betterments.

AT the annual meeting of the Waukesha (Wis.) Gas and Electric Company the officers named were: President, F. W. Putney; Vice-President, M. H. Stroud; Secretary, T. W. Haight; Treasurer, T.W. Robinson.

THE death of Mr. Robt. B. Saul, son of the late Joseph Saul, who was the inventor of the ordinary fishtail gas burner, occurred at his home in Frankford avenue, Holmesburg, district of Philadelphia, the afternoon of the 6th inst. He was in his 71st year, and was still actively engaged in business, not a small part of which, by-the-way, was the producing of the burner invented by his father 60 years ago.

THE Trustees of Redlands, Cal., have adopted an ordinance putting the gas rate for the current year at $1.10 per 1,000 cubic feet. When the local gas and electric concerns made an arrangement to merge their interests, which determination was arrived at not long ago, the rate was put at $1.35 per 1,000. The legality of the Trustees' measure will be tested in the courts.

SECTION 1, Ordinance No. 338, which was incorporated as part of the municipal laws of Cincinnati, O., Feb. 17, 1908, which created the office of inspector of gas and electric meters, and provided also for the ways of such inspection, was amended this year by the passage of the following, entitled Section 1b.: The inspector shall likewise act as general chemist for the Board of Public Service, and at its request shall analyze and report upon coal, building material and paving material and other substances used or intended to be used, or the use of which is considered by the Board in any department or work in charge of said Board. Well, that inspector will not have much of a sinecure, if he attempts to even glance over that list of "duties to do.'"

WE understand that Messrs. Wright and Hess, of Porterville, Cal., have been awarded the contract for the construction of the new gas plant at Coalinga, Cal., otherwise known to fame as the Coalinga Gas and Power Company. The contract price, which is exclusive of the distribution system proper, is said to amount to $71,000.

THE contract for the generating machinery for the new plant of the Charles City (Ia.) Gas Company has been awarded to the Gas Machinery Company, of Cleveland, O. Under the agreement the work must be completed by August 1st.

A CORRESPONDENT in Washington, D. C., forwards the following under date of the 18th inst.: "Owing to the failure of Congress to provide funds for the construction of a gas plant and balloon house at the Fort Myer aerodrome, Gen. James Allen, Chief Officer of the signal corps, has been forced to change his plans for the aeronautical trials and tests at Fort Myer this summer. The army motor balloon, No. 1, purchased last fall, has been inflated and ready to make a flight at Fort Myer for the past week, but the circus tent in which it is housed over night when flights are being made, is not regarded as safe and the officers are not willing to risk removing it from its winter shed. The motor balloon will be shipped immediately to Fort Omaha, where a modern hydrogen gas plant and balloon house has been erected. Within 10 days the balloon detachment, and Lieuts. Lahm, Foulois, Winter, Bamberger and Dickenson, of the aeronautical division, will go to Fort Omaha. In the meantime, free flights will be made in the signal corps spherical balloon, No. 11, which has a capacity of 35,000 cubic feet of gas, and can carry 3 men. Lieuts. Lahm and Foulois will return to Washington for the aeroplane trials after instructing the other officers in the handling of the dirigible. The change in the programme for the balloon flights will not interfere in the plans for the Wright brothers' and Herring aeroplane trials at Fort Myer."

THE contracts for the construction of the new gas plant at Orange, Tex., have not yet been awarded, although the time set in the franchise for such proceedings has elapsed. We understand, however, that the authorities will agree to an extension of the time limit to August 1st.

THE Fleischbacker-Mack combination, which controls the concern known in San Francisco as the City Electric plant, has about reached the point where its belongings will speedily become the property of the California Gas and Electric Corporation.

The Market for Gas Securities.

The market for Consolidated was rather oddly-shaped in the interim. A sharp upward movement carried the price early in the week up at least 4 points, and an equally sharp selling movement, right after the ex-dividend of 1 per cent. rate, sent it down again. The bid at noon to-day (Friday) was 144¼ to 145. It's cheap, and decidedly cheap, at anything under 150.

Brooklyn Union is 138 to 140; Massachusetts common is 65½ to 66, and Peoples, of Chicago, is 114¾ to 115. The bond market is active, with sales following increases in values.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

1 WALL STREET, NEW YORK CITY.

MAY 24.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated Gas Co.	$78,177,000	100	144¼	145
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,800,000	100	155	165
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	101½
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	100	101
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	104	107
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	94	100
Standard	5,000,000	100	—	75
Preferred	5,000,000	100	70	100
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	138	140
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91½	92
Yonkers	299,650	500	120	—
Out-of Town Companies.				
Bay State	50,000,000	50	1½	1¾
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	90	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	60	60½
Capital, Sacramento	800,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,000,000	1,000	104	106¼
Cincinnati Gas and Electric Co.	20,500,000	100	92	98
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus (O.) Gas Lt. & Heating Co.	1,665,750	100	90¼	91
Preferred	2,026,500	100	75¼	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,800,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	458,000	—	102	105
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100¼
Detroit Gas Co., 5's	381,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104¾	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	103	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 6's	230,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede Gas Co., St. Louis	10,000,000	100	—	100
Preferred	2,500,000	100	60	90
Bonds	10,000,000	1,000	104	104¼
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas and Electric Co.				
" 1st Mtg. 6's	350,000	1,000	106	108½
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	65¼	66
Preferred	25,000,000	100	93	93½
Montreal Gas Co., Canada	2,000,000	100	218	218½
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	127	128
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	114¾	115
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	105½
San Francisco Gas Co., Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	100	103
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112¾	115
General Mortgage, 5's	2,465,000	1,000	90	95
Syracuse Gas Co., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	100	101
Washington (D. C.) Gas Co.	2,600,000	20	343¾	347½
1st Mortgage, 6's	600,000	—	—	—
Western Gas Co., Milwaukee	4,000,000	—	—	—

Advertisers' Index.

GAS ENGINEERS.

Bartlett-Hayward Co., Baltimore, Md. 957
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Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
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Frank D. Moses, Trenton, N. J. 938
Frederick J. Mayer, New York City. 937
Henry I. Lea, Chicago, Ills. 956
H. M. Byllesby & Co., Chicago, Ills. 956
Humphreys & Glasgow, New York City. 956
Improved Equipment Company, New York City. 938
Isbell-Porter Co., Newark, N. J. 944
Kerr Murray Mfg. Co., Fort Wayne, Ind. 957
Laclede-Christy Clay Products Co., St. Louis, Mo. 942
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 941
Quintard Iron Works, New York City. 945
The Gas Machinery Co., Cleveland, O. 936
The United Gas Improvement Co., Philadelphia, Pa. 951
Western Gas Construction Co., Fort Wayne, Ind. 964
William A. Baehr, Chicago, Ills. 934

GAS WORKS APPARATUS AND CONSTRUCTION.

Bartlett-Hayward Co., Baltimore, Md. 957
Chamber Oven Co., Milwaukee, Wis. 939
Connelly Iron Sponge & Governor Co., New York City. 953
Continental Iron Works, Brooklyn, N. Y. 954
Cruse-Kemper Co., Philadelphia, Pa. 944
Davis & Farnum Mfg. Co., Waltham, Mass. 956
Deily & Fowler Mfg. Co., Philadelphia, Pa. 960
Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
Evens & Howard Firebrick Co., St. Louis, Mo. 952
Gas Engineering Co., Trenton, N. J. 938
Humphreys & Glasgow, New York City. 956
Improved Equipment Company, New York City. 938
Isbell-Porter Co., New York City. 944
Kerr Murray Mfg. Co., Fort Wayne, Ind. 957
Laclede-Christy Clay Products Co. St. Louis, Mo. 942
Lloyd Construction Co., Detroit, Mich. 946
Quintard Iron Works Co., New York City. 945
R. D. Wood & Co., Philadelphia, Pa. 959
Riter-Conley Mfg. Co., Pittsburgh, Pa. 943
Stacey Mfg. Co., Cincinnati, O. 939
The Gas Machinery Co., Cleveland, O. 936
The United Gas Improvement Co., Philadelphia, Pa. 951
Western Gas Construction Co., Fort Wayne, Ind. 964

PROCESSES.

Bartlett-Hayward Co., Baltimore, Md. 957
Chamber Oven Co., Milwaukee, Wis. 939
Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
Humphreys & Glasgow, New York City. 956
Improved Equipment Company, New York City. 938
The Gas Machinery Co., Cleveland, O. 936
The United Gas Improvement Co., Philadelphia, Pa. 951
Western Gas Construction Co., Fort Wayne, Ind. 964

SCRUBBERS AND CONDENSERS.

Bartlett-Hayward Co., Baltimore, Md. 957
Continental Iron Works, Brooklyn, N. Y. 954
Cruse-Kemper Co., Philadelphia, Pa. 944
Davis & Farnum Mfg. Co., Waltham, Mass. 956
Economical Gas Apparatus Construc. Co. Toronto, Ont. 934
Evens & Howard Firebrick Co., St. Louis, Mo. 952
Isbell-Porter Co., Newark, N. J. 944
Kerr Murray Mfg. Co., Fort Wayne, Ind. 954
Quintard Iron Works, New York City. 945
R. D. Wood & Co., Philadelphia, Pa. 958
Riter-Conley Mfg. Co., Pittsburgh, Pa. 943
Stacey Mfg. Co., Cincinnati, O. 959
The Gas Machinery Co., Cleveland, O. 936
The United Gas Improvement Co., Philadelphia, Pa. 951
Western Gas Construction Co., Fort Wayne, Ind. 964

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
R. D. Wood & Co., Philadelphia, Pa. 958

TAR AND CARBONIC ACID EXTRACTOR.

Bartlett-Hayward Co., Baltimore, Md. 957
Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
Isbell-Porter Co., Newark, N. J. 944
Kerr Murray Mfg. Co., Fort Wayne, Ind. 957
Stacey Mfg. Co., Cincinnati, O. 959
The Gas Machinery Co., Cleveland, O. 936
The United Gas Improvement Co., Philadelphia, Pa. 951
Western Gas Construction Co., Fort Wayne, Ind. 964

AMMONIA CONCENTRATORS.

Bartlett-Hayward Co., Baltimore, Md. 957
Michigan Ammonia Works, Detroit, Mich. 934
The Gas Machinery Co., Cleveland, O. 936
Western Gas Construction Co., Fort Wayne, Ind. 964

GAS METERS.

American Meter Co., New York and Philadelphia. 963
D. McDonald & Co., Albany, N. Y. 961
Helme & McIlhenny, Philadelphia, Pa. 963
John J. Griffin & Co., Philadelphia, Pa. 916
Keystone Meter Co., Royersford, Pa. 962
Maryland Meter and Mfg. Co., Baltimore, Md. 962
Metric Metal Co., Erie, Pa. 963
Nathaniel Tufts Meter Co., Boston, Mass. 962
New York Improved Meter Co., New York City. 962
Pittsburg Meter Co., East Pittsburg, Pa. 948
Rotary Meter Co., New York City. 935
Sprague Meter Co., Bridgeport, Conn. 961
United States Meter Co., Brooklyn, N. Y. 963

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia. 963
D. McDonald & Co., Albany, N. Y. 961
Helme & McIlhenny, Philadelphia, Pa. 963
John J. Griffin & Co., Philadelphia, Pa. 916
Keystone Meter Co., Royersford, Pa. 962
Nathaniel Tufts Meter Co., Boston, Mass. 962
New York Improved Meter Co. New York City. 962
Pittsburg Meter Co., East Pittsburg, Pa. 6
Sprague Meter Co., Bridgeport, Conn. 961

PREPAYMENT METER ATTACHMENTS.

New York Improved Meter Co., New York City. 962

WATER METERS.

Pittsburg Meter Co., East Pittsburg, Pa.

GAS AND WATER PIPES.

Davis & Farnum Mfg. Co., Waltham, Mass. 956
Donaldson Iron Co., Emaus, Pa. 948
Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
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GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 954
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The Gas Machinery Co., Cleveland, O. 936
Western Gas Construction Co., Fort Wayne, Ind. 964

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Stacey Mfg. Co., Cincinnati, O..... 959

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C. M. Keller, Columbus, Ind..... 955

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Chaplin-Fulton Mfg. Co., Pittsburg, Pa..... 959
Connelly Iron Sponge & Governor Co., New York City. 953
Evens & Howard Firebrick Co., St. Louis, Mo..... 952
Isbell-Porter Co., Newark, N. J..... 944
Pittsburg Meter Co., East Pittsburg, Pa..... 946
R. D. Wood & Co., Philadelphia, Pa..... 958
Reynolds Gas Regulator Co., Anderson, Ind..... 955

CEMENTS.

C. L. Gerould, New Castle, Pa..... 962

RETORTS AND FIREBRICKS.

Baltimore Retort and Firebrick Co., Baltimore, Md... 952
Chamber Oven Co., Milwaukee, Wis..... 939
Didier-March Co., New York City..... 937
Evens & Howard Firebrick Co., St. Louis, Mo..... 952
Gas Bench Construction Co., St. Louis, Mo..... 945
Henry Maurer & Son, New York City..... 945
Improved Equipment Company, New York City..... 938
James Gardner, Jr., Co., Bolivar, Pa..... 954
J. H. Gautier & Co., Jersey City, N. J..... 952
Laclede-Christy Clay Products Co., St. Louis, Mo..... 942
Missouri Firebrick Co., St. Louis, Mo..... 952
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.... 941

INCLINED RETORTS.

Baltimore Retort and Firebrick Co., Baltimore, Md... 952
Didier-March Co., New York City..... 937
Gas Bench Construction Co., St. Louis, Mo..... 945
Improved Equipment Company, New York City..... 938
Laclede-Christy Clay Products Co., St. Louis, Mo..... 942
Parker-Russell Mining and Mfg. Co., St. Louis, Mo... 941

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Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 953
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Improved Equipment Company, New York City..... 938
Laclede-Christy Clay Products Co., St. Louis, Mo..... 942
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.... 941

REGENERATIVE FURNACES.

Baltimore Retort and Firebrick Co., Baltimore, Md.. 952
Bartlett, Hayward & Co., Baltimore, Md..... 957
Didier-March Co., New York City..... 937
Gas Bench Construction Co., St. Louis, Mo..... 945
Improved Equipment Company, New York City..... 938
J. H. Gautier & Co., Jersey City, N. J..... 954
Missouri Firebrick Co., St. Louis, Mo..... 152
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.... 941

SELF-SEALING MOUTHPIECE DOORS.

Bartlett-Hayward Co., Baltimore, Md..... 957
Continental Iron Works, Brooklyn, N. Y..... 958
Davis & Farnum Mfg. Co., Waltham, Mass..... 956
Isbell-Porter Co., Newark, N. J..... 944
Improved Equipment Company, New York City..... 938
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 957
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 941
Quintard Iron Works, New York City..... 945
R. D. Wood & Co., Philadelphia, Pa..... 958
Stacey Mfg. Co., Cincinnati, O..... 959
The Gas Machinery Co., Cleveland, O..... 936
Western Gas Construction Co., Fort Wayne, Ind..... 964

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Davis & Farnum Mfg. Co., Waltham, Mass..... 956
Isbell-Porter Co., Newark, N. J..... 944
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 957
Quintard Iron Works, New York City..... 945
R. D. Wood & Co., Philadelphia, Pa..... 958
Stacey Mfg. Co., Cincinnati, O..... 959
The United Gas Improvement Co., Philadelphia, Pa... 951
Western Gas Construction Co., Fort Wayne, Ind..... 964

VALVES.

Bartlett-Hayward & Co., Baltimore, Md..... 957
Continental Iron Works, Brooklin, N. Y..... 954
Davis & Farnum Mfg. Co., Waltham, Mass..... 956
Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
Isbell-Porter Co., Newark, N. J..... 944
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 957
Ludlow Valve Manufacturing Co., Troy, N. Y..... 956
R. D. Wood & Co., Philadelphia, Pa..... 958
Stacey Mfg. Co., Cincinnati, O..... 959
The Gas Machinery Co., Cleveland, O..... 936
The P. H. & F. M. Roots Co., Connersville, Ind..... 947
Western Gas Construction Co., Fort Wayne, Ind..... 964

PURIFYING MATERIALS.

Connelly Iron Sponge & Governor Co., New York City 953
F. Behrend, New York City..... 956
The United Gas Improvement Co., Philadelphia, Pa... 951

EXHAUSTERS.

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Connersville Blower Company, Connersville, Ind..... 960
Davis & Farnum Mfg. Co., Waltham, Mass..... 956
Isbell-Porter Company, Newark, N. J..... 944
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 957
Piqua Blower Co., Piqua, O..... 945
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H. Mueller Manufacturing Co., Decatur, Ills..... 934

(*Continued on page* 934.)

DIVIDEND NOTICE.

No. 222 S. THIRD ST., Philadelphia, Pa., May 18, 1909.

The Board of Directors of The American Gas Company has this day declared a semi-annual dividend of 3 per cent., or $3 per share, on the capital stock of the Company, payable June 1, 1909, to stockholders of record on May 21, 1909, at 3 P.M. Transfer books close May 21, 1909, and re-open June 1, 1909. Checks will be mailed.

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(Concluded from page 933.)

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Western Gas Construction Co., Fort Wayne, Ind..... 964

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Bartlett-Hayward Co., Baltimore, Md. 957
Continental Iron Works, Brooklyn, N. Y..... 954
Cruse-Kemper Co., Philadelphia, Pa..... 944
Davis & Farnum Mfg. Co., Waltham, Mass..... 946
Deily & Fowler Mfg. Co., Philadelphia, Pa..... 960
Economical Gas Apparatus Construc. Co., Toronto, Ont. 934
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 937
R. D. Wood & Co., Philadelphia, Pa..... 938
Riter-Conley Mfg. Co., Pittsburgh, Pa..... 948
Stacey Mfg. Co., Cincinnati, O..... 959
Western Gas Construction Co., Fort Wayne, Ind..... 964

STORAGE TANKS.

Bartlett-Hayward Co., Baltimore, Md..... 957
Davis & Farnum Mfg. Co., Waltham, Mass..... 956
Quintard Iron Works, New York City..... 945
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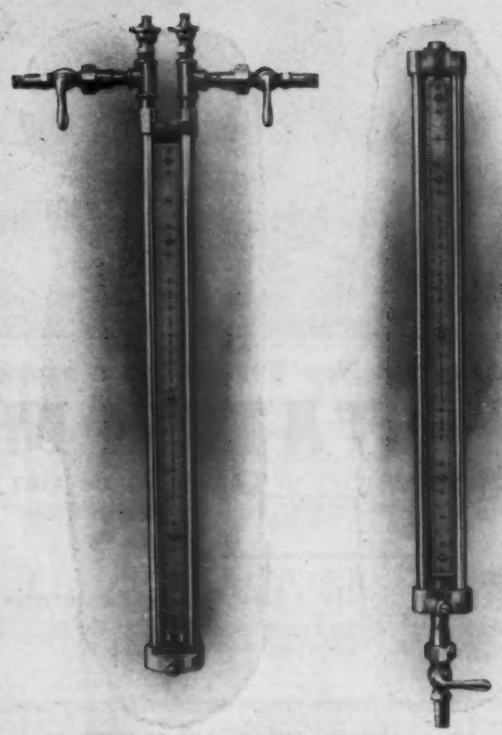

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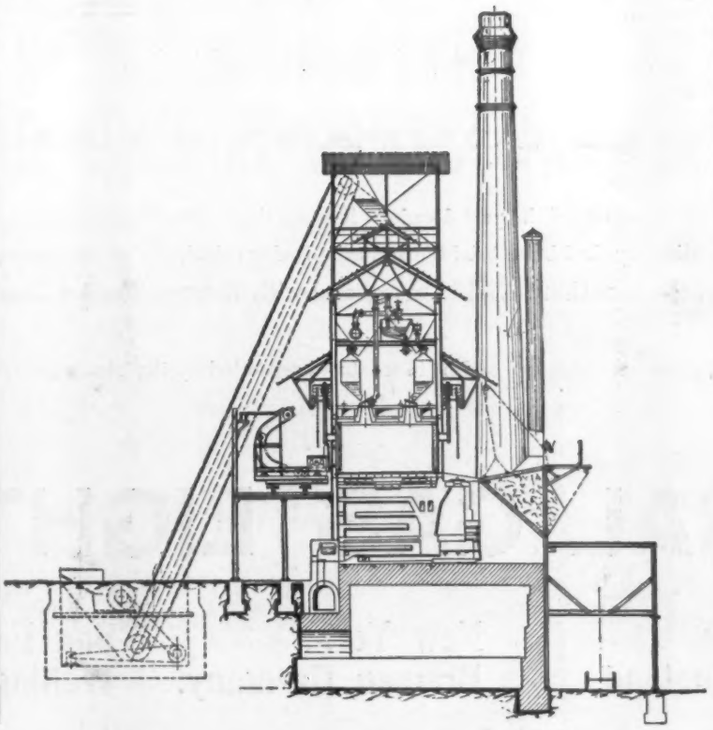

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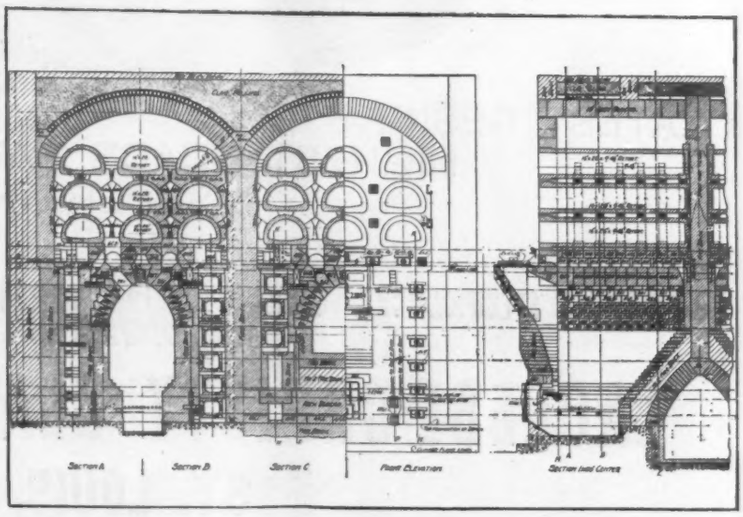

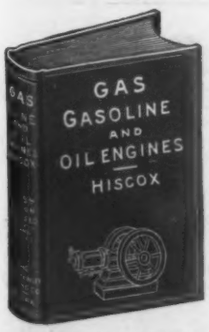

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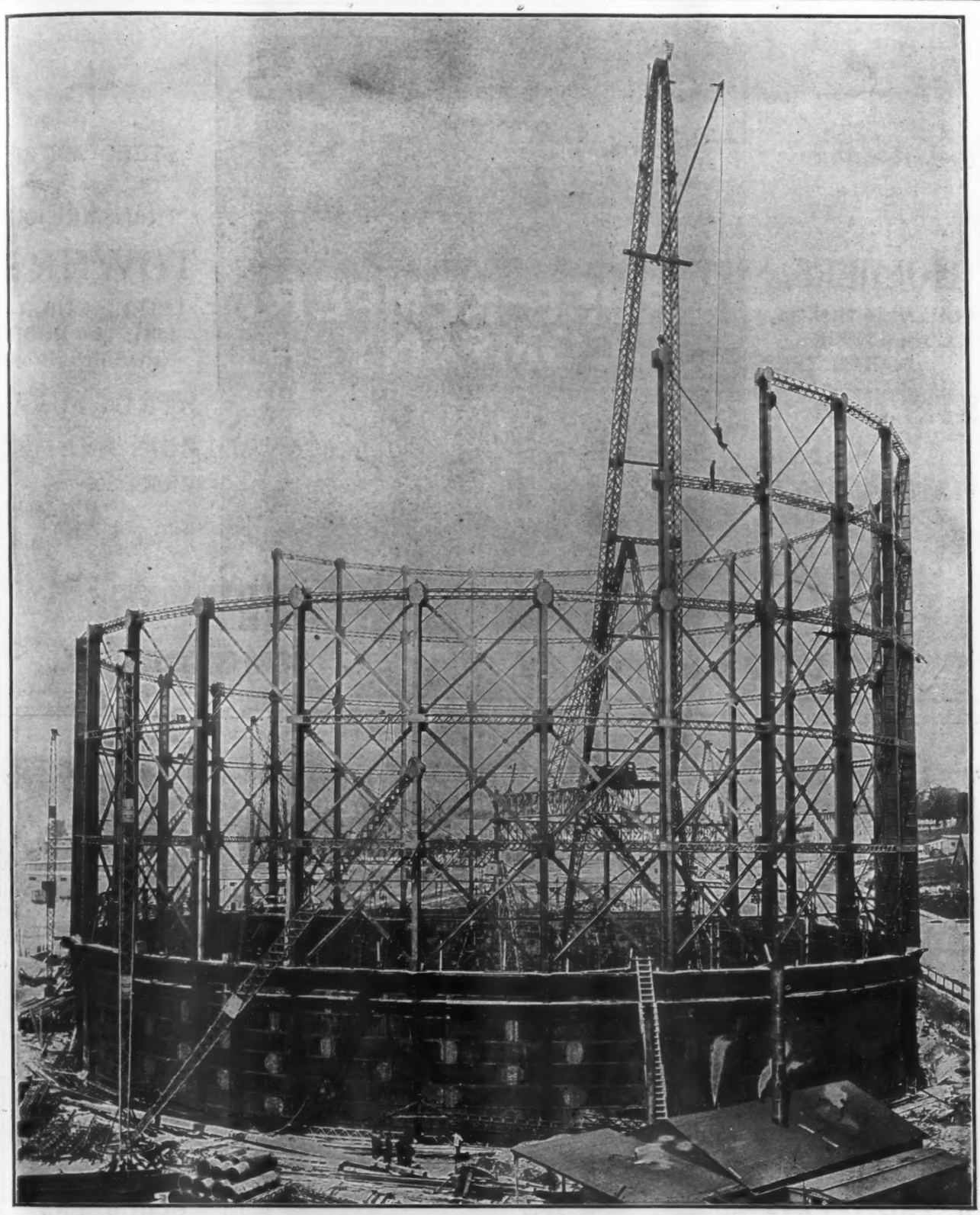

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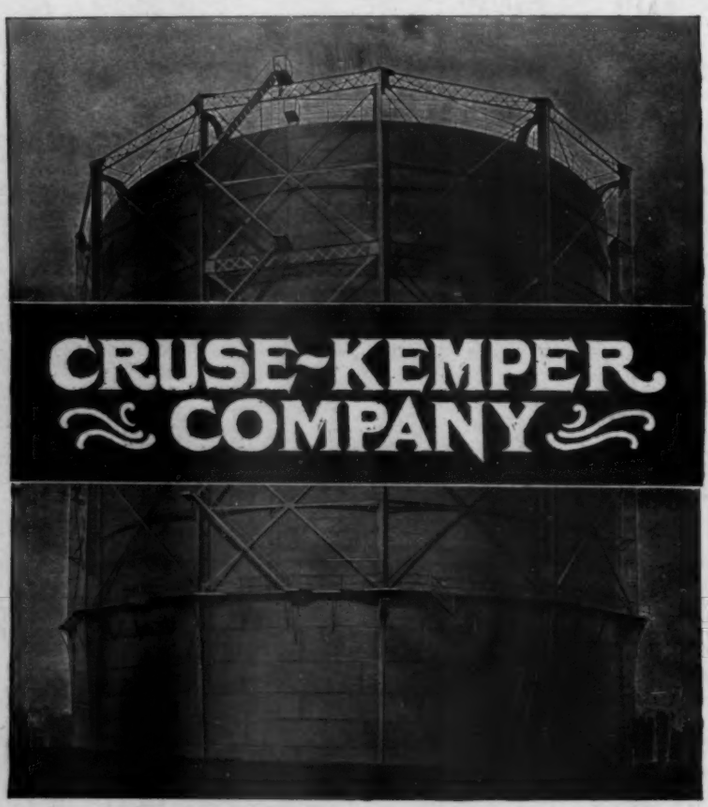

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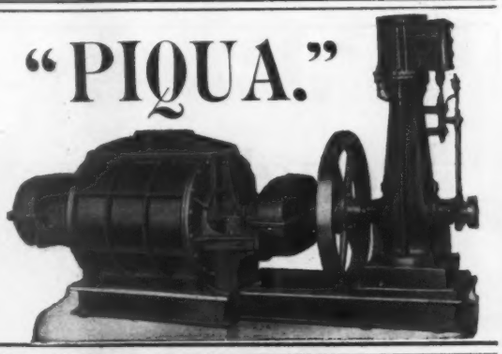

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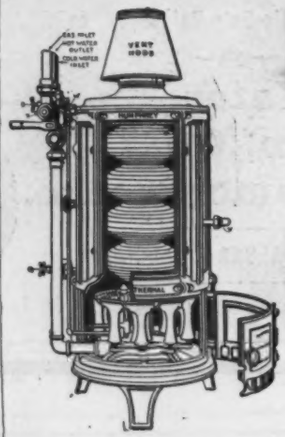

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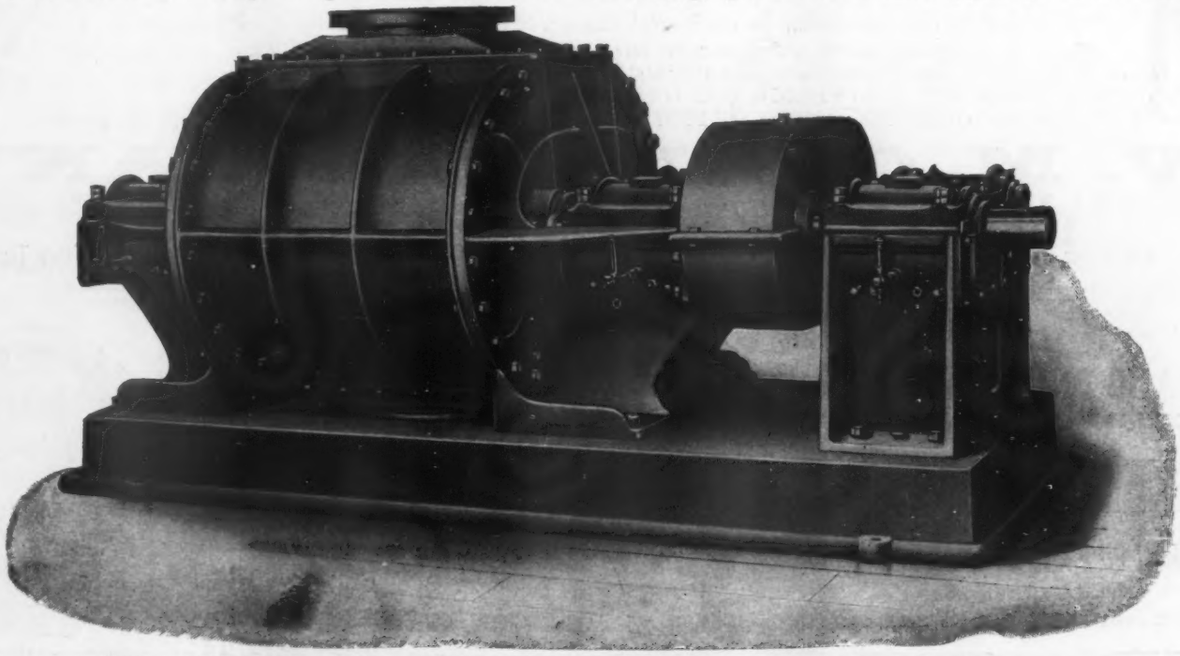

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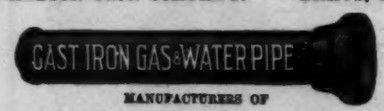

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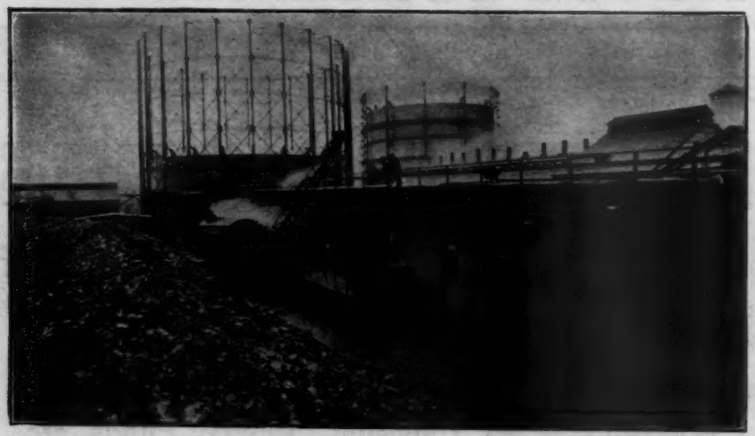

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PUBLIC LIGHTING TABLE.

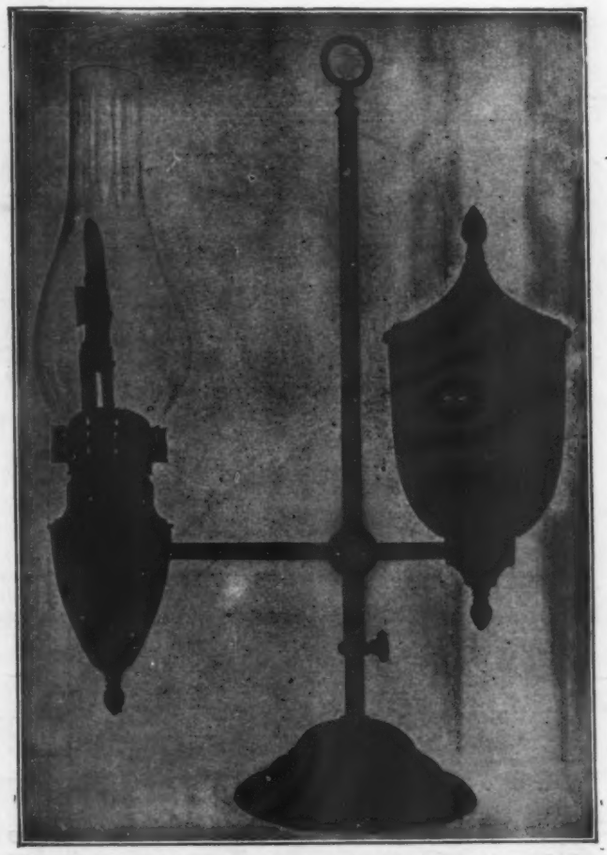
JUNE, 1909.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Tue.	1	2.40AM	3.30AM
Wed.	2	No L.	No L.
Thu.	3	No L.PM	No L.
Fri.	4	No L.	No L.
Sat.	5	7.50PM	10.20PM
Sun.	6	8.00	11.10
Mon.	7	8.00	12.00
Tue.	8	8.00	12.40AM
Wed.	9	8.00	1.20
Thu.	10	8.00LQ	1.50
Fri.	11	8.00	2.20
Sat.	12	8.00	2.40
Sun.	13	8.00	3.10
Mon.	14	8.00	3.30
Tue.	15	8.00	3.30
Wed.	16	8.00	3.30
Thu.	17	8.00NM	3.30
Fri.	18	8.00	3.30
Sat.	19	8.00	3.30
Sun.	20	8.00	3.30
Mon.	21	8.00	3.30
Tue.	22	10.10	3.30
Wed.	23	10.40	3.30
Thu.	24	11.10	3.30
Fri.	25	11.30FQ	3.30
Sat.	26	11.50	3.30
Sun.	27	12.10AM	3.30
Mon.	28	12.40	3.30
Tue.	29	1.10	3.30
Wed.	30	1.50	3.30

TOTAL HOURS DURING 1909.

By Table No. 1.

	Hrs.Min.
January	212.20
February	183.40
March	173.00
April	151.10
May	144.10
June	138.50
July	145.40
August	160.30
September	180.00
October	201.00
November	216.30
December	233.40
Total, yr.	2140.30



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3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

JUNE, 1909.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. All Night Lighting. Complete Lighting in One Hour From Time Given P. M.	Complete Extinguishing in 50 Minutes From Time Given A. M.
Tue.	1	7.12	3.17
Wed.	2	7.12	3.17
Thu.	3	7.12	3.17
Fri.	4	7.17	3.12
Sat.	5	7.17	3.12
Sun.	6	7.17	3.12
Mon.	7	7.17	3.12
Tue.	8	7.17	3.12
Wed.	9	7.17	3.12
Thu.	10	7.17	3.12
Fri.	11	7.17	3.07
Sat.	12	7.17	3.07
Sun.	13	7.17	3.07
Mon.	14	7.17	3.07
Tue.	15	7.17	3.07
Wed.	16	7.17	3.07
Thu.	17	7.17	3.07
Fri.	18	7.22	3.07
Sat.	19	7.22	3.07
Sun.	20	7.22	3.07
Mon.	21	7.22	3.07
Tue.	22	7.22	3.07
Wed.	23	7.22	3.07
Thu.	24	7.22	3.07
Fri.	25	7.27	3.07
Sat.	26	7.27	3.07
Sun.	27	7.27	3.07
Mon.	28	7.27	3.07
Tue.	29	7.27	3.07
Wed.	30	7.27	3.07

TOTAL HOURS DURING 1909.

	Hrs.Min.
January	428.30
February	358.15
March	353.10
April	298.10
May	263.20
June	234.45
July	248.30
August	278.00
September	311.25
October	370.05
November	397.40
December	438.35
	3980.25
Deduct on account of 50 min. extinguishing time	30.25
Total, yr.	3950.00

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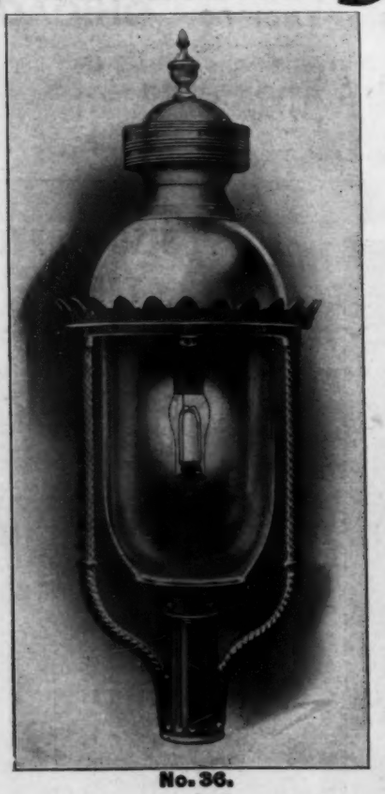

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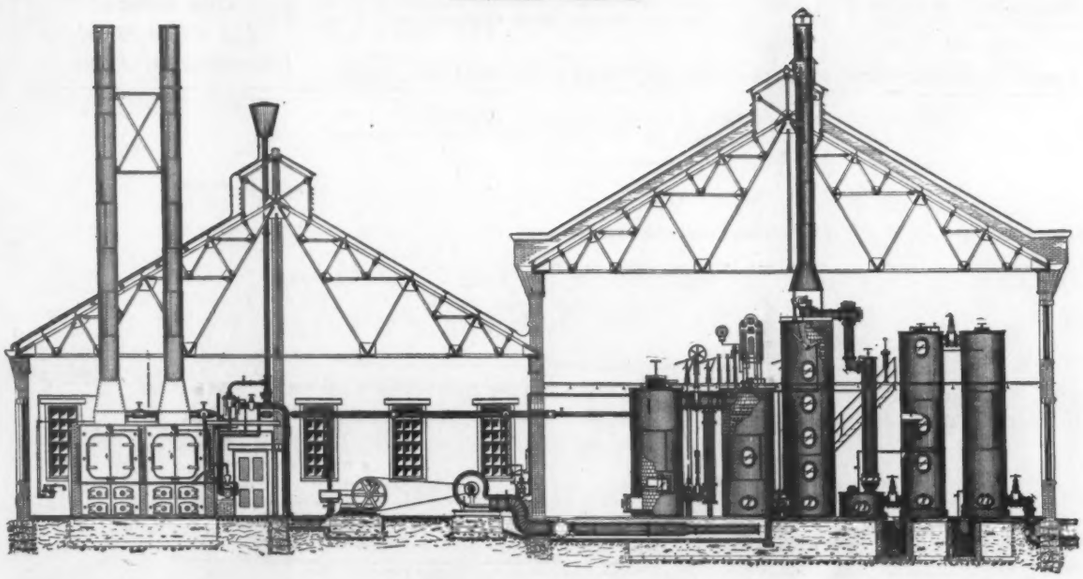

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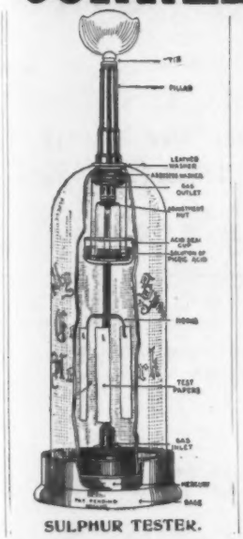

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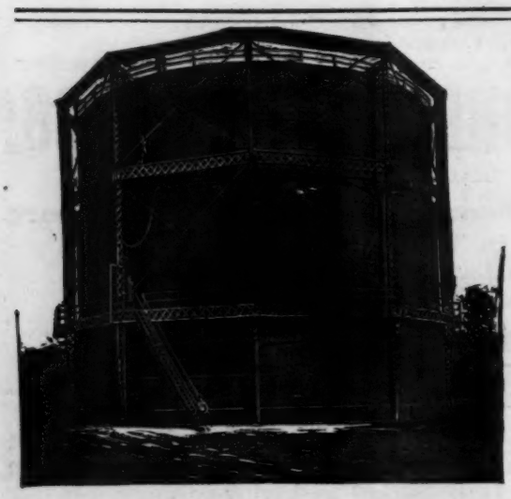

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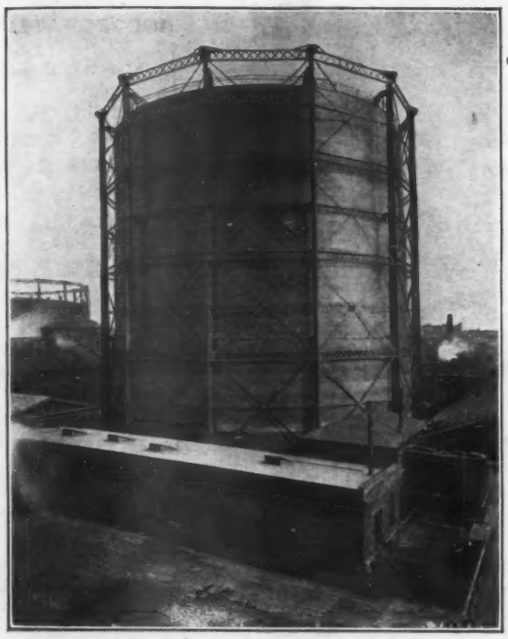

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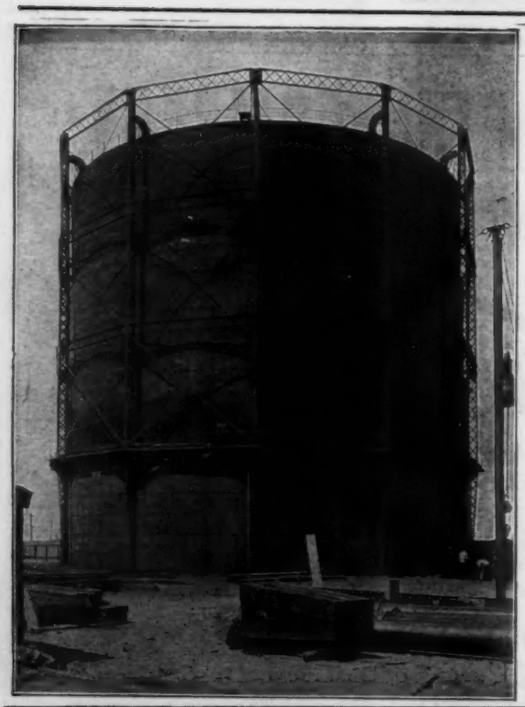

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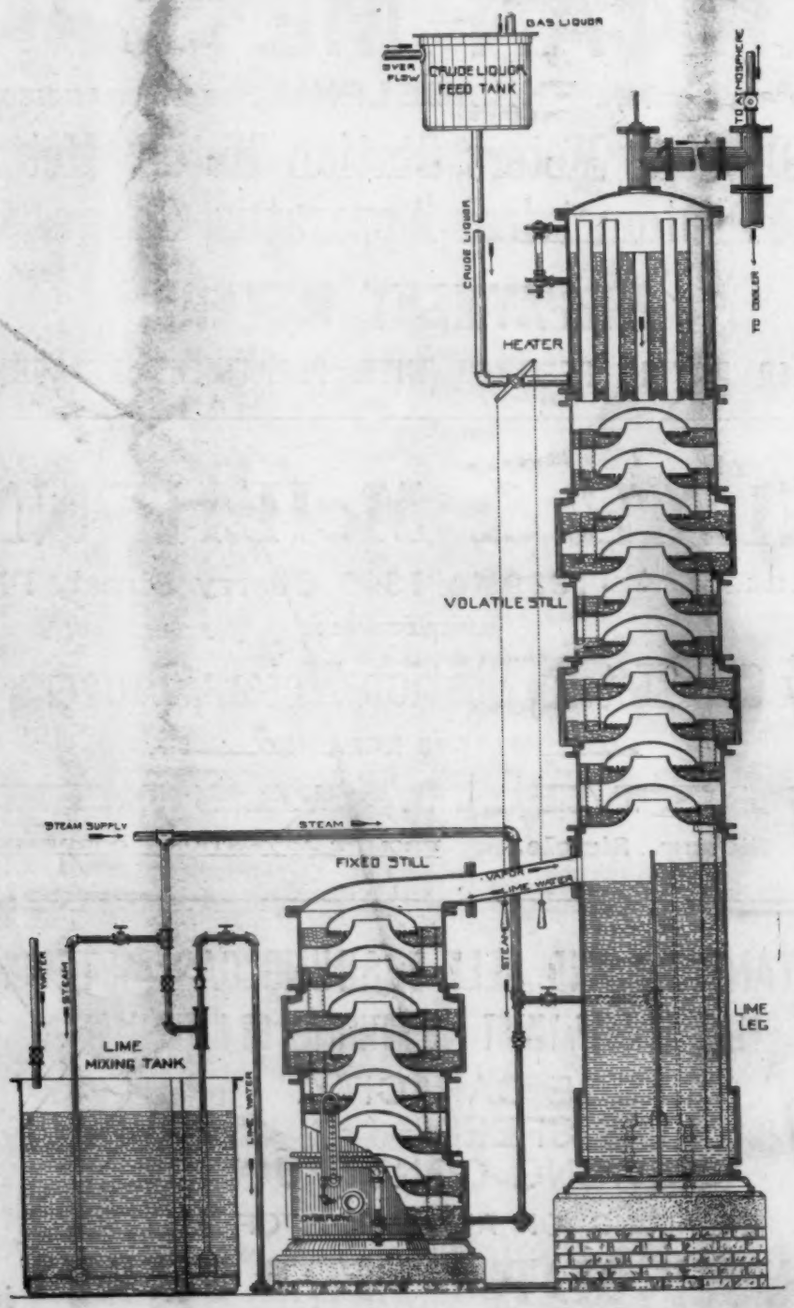

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